Essays in Bank Credit Ratings

Sifodaskalakis, Emmanouil

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Emmanouil Sifodaskalakis

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This dissertation is dedicated to the memory of my best friend, Manos Poulakas,
who passed away on July 26, 2019.

General Introduction

Credit rating agencies (CRAs) have repeatedly faced widespread criticism in different occasions during the past two decades regarding the quality of their ratings. The most prominent incidents of note where the published ratings were challenged have been the Asian financial crisis in 1997, the high-profile corporate collapses in 2001-2 and lastly the global financial crisis of 2007-8. For the global financial crisis of 2007-8, the failure of large financial institutions was partly attributed to the failure of corporate governance and risk management of financial institutions, and partly to the CRAs rating methodologies with respect to financial institutions. In this dissertation, we investigate those two factors that have been claimed that were behind global crises during the past two decades. First, we examine whether the three principal CRAs have incorporated governance characteristics in their analysis. We examine the existence of corporate governance in bank ratings and how they differ among CRAs. Next, we examine the time variation in bank credit rating standards for the existence of structural breaks. The popular claim is that the CRAs have constantly followed an apparent stringency in the rating standards, which was interrupted by the loosening of rating standards before the global financial crisis of 2007-8. So, we examine the assertion that the CRAs followed such patterns in bank rating standards that could be a factor that precipitated the crisis. The third essay examines an alternative explanation to that of tightening rating standards. CRAs have also been criticized for the lack of timeliness in predicting some high-profile bankruptcies. We investigate the existence of stickiness in bank rating standards that could have been caused by the lack of timeliness in bank ratings.

In the essay 1 titled, “Governance and Bank Credit Ratings”, we examine whether the element of corporate governance is considered in the published bank credit ratings by the three principal CRAs. Our evidence is drawn by controlling for bank financial characteristics and sovereign ratings that prior research has shown to be related to credit ratings. Evidence is initially drawn using principal components drawn from PCA analysis of all available governance variables, and then results are confirmed using a selection of governance variables that formulate our base model for governance in bank ratings. Similar evidence to that for governance variables is presented using a set of country institutional components, and lastly we examine changes in relationship between governance variables and bank credit ratings for any of the three principal CRAs for the periods before and after the global financial crisis.

In Essay 2 titled "Structural Shifts in Bank Credit Ratings", we examine the time-series variation in bank rating standards of the three principal CRAs for the period 1990-2015, for different geographical regions. We distinguish three structural breaks in the bank rating standards dividing the time-span of our analysis to the period before and after the 2001-2 high profile corporate collapses when credit rating standards tightened, the period before the global financial crisis started when bank credit rating standards loosened, and the period after the global financial crisis when bank credit rating standards tightened. Fitch has followed a constant tightening of bank rating standards throughout, while this 'trend' was intensified after the global financial crisis. This pattern for Fitch is more intense for European, and US and Canadian banks. Moody's and Standard & Poor's were rather more aligned in the structural shifts of their rating standards for the period under investigation. For Moody's the loosening of bank rating standards in the pre global financial crisis period is more evident for European banks, compared to the US and Canadian banks, while the hardening of bank rating standards in the post global financial crisis period is more intense for European, US and Canadian banks, and not evident for the rest of the world banks. For Standard & Poor's the loosening of bank rating standards in the pre global financial crisis period is almost the same for all geographical regions, while the hardening of bank rating standards in the post global financial crisis period is very intense for the US and Canadian banks, and much less intense for European, US and Canadian banks. Lastly, in the presence of competition, Fitch gives higher credit ratings for US, Canadian and RoW banks.

Essay 3 discusses an alternative explanation to that of tightening rating standards. In Essay 3, titled "Stickiness in Bank Credit Ratings", we examine the existence of stickiness in bank rating standards that could have been caused by the lack of timeliness in bank rating. The results support our assumption that bank ratings by the three principal CRAs are sticky. Another main finding is that there is clear evidence of asymmetry between upgrade and downgrade decisions in bank ratings by all three principal CRAs, with upgrades becoming increasingly difficult while downgrades remaining the same. Further evidence includes a further asymmetry with respect to high versus low credit quality bank ratings, and the existence of chronological structural breaks in stickiness practices of bank rating standards.

This dissertation makes significant contributions to the credit rating literature from both a policy and an academic perspective. For one thing, the focus on bank ratings adds to the existing rating literature that is typically focused on corporate ratings. All three aspects of bank credit ratings investigated give significant insights on how the three principal credit rating agencies rate banks, and how they performed in different occasions during the past two decades.

Contents

Governance and Bank Credit Ratings

ABSTRACT

Corporate governance has been blamed at different occasions in the past two decades as a key factor of financial turmoil. The most recent global financial crisis of 2007-8 has reopened the discussion of the importance of corporate governance that had gained much attention in the past on the aftermath of the 2001-2 high profile corporate collapses. Using a commonly accepted framework for evaluating bank ratings, we find evidence that governance attributes explain bank credit ratings. We come to this conclusion initially by using principal components drawn from PCA analysis of a large group of governance variables and then by a selection the governance variables. Similar evidence is presented using a set of country institutional components. Lastly, we find no evidence that the relationship between governance and bank credit ratings for any of the three principal CRAs changes in the periods before and after the global financial crisis, i.e. for the periods until 2008 and from 2009.

1. Introduction

1.1 Background

1.1.1 Corporate Governance and 2007-8 Financial Crisis

The global financial crisis of 2007-8 has reopened the discussion of the importance of corporate governance that had gained much attention in the past on the aftermath of the 2001-2 high profile corporate collapses. Clearly, the reasons that corporate governance has once again become a major issue are not the same as they were in the past. The 2001-2 corporate collapses were mainly involved with accounting fraud, whereas in the 2007-8 financial crisis the failure of large financial institutions has been partly attributed to failure of corporate governance and risk management. Within this context, during the past years substantial academic work and policy analysis has attempted to gain insight into the governance problems exposed by the financial crisis and in particular the governance of banks.

It is widely known that at the basis of the developments in the financial markets, known as the global financial crisis, was the bursting of the U.S. housing bubble. This in turn was the consequence of a complex combination of policies that encouraged home ownership, providing easier access to loans, overvaluation of subprime mortgages, etc. Many large institutions around the world were about to collapse, and this was prevented by the massive bailout programs by initiated by national governments. Nevertheless, the financial crisis led to the failure of 465 banks in the U.S., whereas in the five years prior to 2008, only 10 banks had failed.

In the aftermath of the financial crisis, policymakers around the world tried to understand in some detail the causes that led to this point. One of the most distinctive conclusions for the financial crisis was that reached by the Financial Crisis Inquiry Commission (F.C.I.C.) in the U.S. that was published in January 2011. F.C.I.C. concluded that the financial crisis was avoidable and was caused among other reasons by "widespread failures in financial regulation and supervision," "dramatic failures of corporate governance and risk management at many systemically important financial institutions," "a combination of excessive borrowing, risky investments, and lack of transparency" by financial institutions.

Yet, even though empirical research on corporate governance and the global financial crisis of 2007-8 have found evidence that bank governance was

associated with the crisis, it has been difficult to establish a direct link between bank failures and corporate governance. There are two forces at play behind this lack of strong evidence. First, as governments have intervened to rescue banks that failed and thus camouflaged the extent to which bad governance had caused the failures. Second, despite these supporting policies, the global financial crisis exposed many illnesses of the financial system that have contributed to increased bank failures. As these two forces influence the opposite signs of the relationship, it was difficult to establish a robust statistical relationship on the net effect of bad governance.

1.1.2 Definition of Corporate Governance

But before we address the question why and how the governance of banks differs from the governance of non-financial corporations; we should first briefly give a definition of corporate governance.

According to the glossary of corporate governance-related terms in Organisation for Economic Co-operation and Development (OECD), corporate governance is defined as a set of relationships between a company's management, its board, its shareholders and other stakeholders which provides the structure through which the objectives of the company are set, and the means of attaining those objectives and monitoring performance. In other words, corporate governance helps define the way in which authority and responsibility are distributed within a firm and the way corporate decisions are made in order to ensure that all the financial stakeholders, i.e. both shareholders and other stakeholders, receive a fair share of the firm's earnings and assets.

Furthermore, according to Standard & Poor's (2008) corporate governance can be used as means to minimize a firm's non-financial risks. Most of the credit risk agencies like Standard & Poor's, consider the assessment of corporate governance largely as a qualitative exercise, in contrast with other forms of analysis such as financial statement analysis where quantitative measures guide the assessment of a firm.

1.1.3 Governance in Banking

Corporate governance in banks differs from that of non-financial firms in many ways. The most distinct characteristic of bank governance is that it is not only shareholders that are at risk from a bank's activities. The stakeholders of a bank are numerous and besides shareholders they consist of depositors, debtholders and in most countries the taxpayers or the government as the insurer of deposits.

Moreover, the financial well-being of a bank or the banking system is crucial for the financial system as a whole, which means that there exist externalities that need to be regulated in a most efficient way.

Also, banks are characterized by the large size of their debt, which on average is over 90 percent of their balance sheet compared to about 40 percent of the average for non-financial firms. So, the situation is that the shareholders who are hold well diversified portfolios, reflecting their risk preferences, being a minority of a bank's stakeholders, control the firm and impose their preference of risk composition which in most instances, shareholders' risk preferences are in conflict with the preference of all other stakeholders.

A third distinct characteristic is the complexity of the banking business as compared to that of the average non-financial firm. The business of a bank is inherently complex and prone to swift changes. Levine (2004) notes that "banks can alter the risk composition of their assets more quickly than most nonfinancial industries". So, opacity should be added to complexity in the banking business, as it is structurally inherent in banking assets (Morgan, 2002). So, not only complexity but also opacity play a significant role in bank governance and the key issue is how well boards of directors understand the inner workings of the bank in order to represent shareholders and protect all stakeholders.

1.2 Motivation

The global financial crisis of 2007-8 has not only reopened the discussion of the importance of corporate governance, but also about the validity of ratings awarded to banks by rating agencies, which has attracted the interest of both market participants and academics. Some of the most well discussed issues in the literature are: the role of the agencies in the market (e.g. Kraussl, 2005), the market' s reaction to rating announcements (e.g. Pukthuanthong-Le et al., 2007), the prediction of the credit ratings (e.g. Hwang et al, 2010), and the investigation of their determinants (e.g. Bissoondoyal-Bheenick, 2005).

This essay is related to the last strand of the literature and aims to extend our knowledge of corporate governance, focusing on its role for the ratings assigned to banks. Even though there are many studies that examine corporate governance as a determinant of ratings of non-financial firms, the issuance of bonds, and sovereign ratings, there are considerably fewer studies that examine solely at bank ratings.

Knowledge of the relevant factors that determine the ratings and the creditworthiness of the banks is particularly important for a number of reasons as discussed above, with the most important being the central role banks have in the economy. The well-being of the banking system is vital for economic development and growth, while better understanding of bank ratings can alleviate information asymmetries for investors.

Early studies focused on the financial profile of banks (Poon et al., 1999, 2005) and the regulatory environment (Pasiouras et al., 2006), whereas more recent studies examine the impact of sovereign ratings (Williams et al., 2013), the subprime crisis (Salvador et al., 2014), country-specific variations (Caporale et al., 2012), and information asymmetry (Shen et al., 2012).

Thus, even simple characteristics such as the board members (e.g. education, experience, etc.) have been largely ignored in the literature. In fact, there are very few studies that examine the impact of corporate governance on credit ratings and they are all on non-financial firms (Bhojraj and Sengupta, 2003; Anderson et al., 2004; Ashbaugh-Skaife et al., 2006; Alali et al.,2012; Aman and Nguyen, 2013).

The lack of research on corporate governance and bank ratings is surprising for at least two reasons. First, the rating agencies point out that they integrate governance analysis into bank overall credit rating (e.g. see Bauer et al., 2013, for the Moody's methodology); and yet, the exact process and the weights assigned to the various governance characteristics remain a black box to outsiders. Second, a large number of studies show that corporate governance and board characteristics influence the performance (e.g. Aebi et al., 2012; de Andres and Vallelado, 2008; Erkens et al., 2012), efficiency (Kauko, 2009), and risk-taking (e.g. Berger et al., 2013) of banking institutions.

One last aspect of the motivation for the present essay is that all studies that examine the impact of corporate governance on credit ratings are all single country studies (e.g. Ashbaugh-Skaife et al., 2006). So, it is particularly important to examine how bank level corporate governance, country level governance (i.e. institutional development) and the regulatory environment jointly determine the credit ratings. For example, Bruno and Claessens (2010) conclude that there is a threshold level of country development (i.e. legal investor protection) above which stringent regulation hurts the performance of well governed companies or has a neutral effect for poorly governed companies. However, there is no evidence for

whether and how these characteristics interact in shaping the opinion of the rating agencies.

1.3 Aim and Research Questions

1.3.1 Aim

Prior literature on both the effects of corporate governance on non-financial firms' ratings from the shareholder's perspective and on the relationship of bank governance to risk and performance will be the basis of this paper. Within the context discussed above, the essay aims to close the gap in the literature regarding the lack of research on corporate governance and bank ratings. Since research on bank governance is still an open issue to scholars and policy makers around the world, the intention here is to enhance knowledge on the inadequacies of bank governance that global financial crisis exposed in, while at the same time providing useful insight how the rating agencies incorporate the governance characteristics in their analysis and providing a comparison of the determinants of the three principal CRAs (i.e. Moody's, Fitch, S&P). Within the same context, we also aim to investigate how a country's institutional set-up influences corporate governance and thus how this is taken into account in the credit rating process of banks.

1.3.2 Research Questions

Since there is further room for academic exploration in this research field, the following research topics are identified of particular interest and remain under-explored: The relationship between corporate governance and bank credit ratings and its differences at national level; the evolution of this relationship before, during and after the global financial crisis and the way it has changed before and after the three principal CRAs begun to compile company ratings with corporate governance practices; a comparison of the bank governance determinants of t the three principal CRAs.

In more detail, the essay aims to shed light on the following questions:

1. Using an international sample of banks, do corporate governance and country institutional characteristics affect bank credit ratings of the three principal CRAs?

2. What are the different ways that the three principal CRAs incorporate the governance characteristics in their analysis, and what are the key determinants for each rating agency?
3. Is there a difference in the relationship of bank governance and bank credit ratings, among the three principal CRAs?
4. Is there a difference in the relationship of bank governance and bank credit ratings before the (i.e. until 2008), and after (i.e. after 2009) the global financial crisis?

Before conducting a formal investigation of empirical evidence, we first provide a literature review comprising the theoretical framework in governance and the empirical studies in governance that is followed by the view of bank governance by CRAs, and policy implications. In the last part, we first present our empirical strategy, then empirical results follow, and lastly discussion and conclusion.

2. Literature Review

This section will provide a systematic review on exiting literature. Firstly, the theoretical background for this thesis will be introduced, which includes the principal-agent framework in governance. Secondly, different strands of empirical studies on corporate governance will be presented. Thirdly, the approach to corporate governance that has been followed by the three principal CRAs will be discussed. Fourthly, some policy implications will be discussed with regard to corporate governance in banking.

2.1 Principal-agent framework in governance

The principal-agent literature has given significant insights into the role of governance in firms' ratings, positively or negatively. Probably the first paper to open the "black box" called the firm, was the seminal paper of Jensen and Meckling (1976), which set the principal-agent framework to develop a theory of the ownership structure of the firm and the implications of management behaviour. Within this framework, the separation of ownership and control creates the conditions for managers to make decisions according to their own interests rather than the interests of the shareholders.

As we know the principal-agent problem is observed when the interests of a principal and an agent are in conflict. This may take place because, even though the agent is expected to represent the best interests of the principal without regard for his self-interest, the agent is motivated to act in his own best interests rather than those of the principal. Such circumstances arise within firms, when conflicting interests of one stakeholder may turn against another and causing inefficiencies and financial losses. This leads to the principal-agent problem and the question in corporate governance: How to manage the conflicts of interest that arise from fundamental principal-agent problems in firms?

Since conflicts of interest give rise for moral hazard, firms should try to minimize these situations through the adoption of solid corporate policy. With this respect, in the following sub-sections three major sources of agency conflicts will be discussed. The first is the conflict between management and all external stakeholders—both bondholders and shareholders; the second agency conflict faced by bondholders is the conflict with shareholders, since shareholders in levered firms have incentives to undertake actions that can transfer wealth from

bondholders to themselves. Thirdly, in the last sub-section the effects of large shareholders in corporate governance will be discussed.

2.1.1 Conflicts between management and external stakeholders

The first type of agency conflicts within the Jensen and Meckling (1976) agency theory framework is between management and all external stakeholders—both bondholders and shareholders. The separation of ownership and control in firms causes information asymmetry problems among the parties involved, i.e. all external stakeholders and management. In turn, information asymmetry problems are the root to a moral hazard problem because managers have incentives to pursue their own interests at the expense of external stakeholders.

Before moving on, it is worthwhile to emphasize that the problem of inducing an “agent” or a manager to behave as if he were maximizing the “principal’s” or owner’s equity is quite general. It exists in all sorts of organizations and at every level of management. Self-interested managerial behaviour can take several forms (Shleifer and Vishny, 1997) such as shirking, enjoying privileges, overcompensation, and empire building. For instance, managers may choose to take less risk than shareholders would like them to do so, because their under-diversified wealth -which in most cases is their human capital- is linked to the firm (Holmstrom, 1999). Also, managers may have incentives to increase the firm’s size and scope in order to enjoy greater prestige and more privileges, and also greater compensation, since executive pay tends to increase with firm size and scope. However, unrestrained or unjustified asset growth of a firm has been proved to be highly damaging for shareholders (Cooper et al., 2008).

Therefore, the above forms of self-interested managerial behaviour can potentially result in a decrease of the expected cash flows of the firm, and as a result decrease the expected cash flows of its external stakeholders and simultaneously increase the default risk of bondholders, leading to lower credit ratings. So, it is expected that governance mechanisms that promote better managerial decision making or in other words less self-interested managerial behaviour is expected to promote the interests of all stakeholders.

2.1.1.1 Managerial Compensation

An apparent way to mitigate the agency conflicts between management and stakeholders discussed above is to provide financial incentives to managers. This

is in accordance with principal-agent theory that dictates that shareholders want to increase managers' performance-based compensation by compensation linked to stock performance, i.e. stock options. In this way, managers are rewarded for taking decisions that are beneficial to shareholders and punished for the opposing decisions. In other words, shareholders are induced to compensate managers with stock options since they increase the manager's pay-performance sensitivity. However, this approach that motivates managers to pursue riskier investment strategies, benefit shareholders at the expense of bondholders (Jensen and Meckling 1976).

The approach of managerial compensation described above can be considered as a partial remedy to the agency problem. Another approach is the "managerial power approach" that states that managerial compensation is not only a potential instrument for addressing agency problems, but also a part of the agency problem itself. Under this approach, compensation of managers is excessive, not consistent with basic principles of optimal contracting theory, and it is a result of managerial power (Winter and Michels, 2012).

With respect to empirical research, even though older research suggests that compensation incentives are sufficient to induce managers to make decisions aligned with the interests of shareholders, empirical research before financial crisis of 2007-8 suggested that excess managerial compensation is related to weak governance (Ashbaugh-Skaife et al. 2006). Mehran et al. (2011) make a literature review on the link between Compensation, Performance, and Risk Taking in the financial industry during the financial crisis of 2007-8 and find that most empirical research converge to the view that higher risk-taking incentives lead to higher volatility and that the incentives shareholders gave to managers to pursue riskier investment strategies, did not pay out.

2.1.1.2 Effects of Governance Structures

There has been extensive literature on the role of boards of directors in corporate governance, as it is considered as the shareholders' first line of defence in corporate governance. Some of important factors of governance structures are board size, number or ratio of independent or outside directors and transparency issues, while other less important factors may be board members' education, experience, age, etc.

As far as board size is concerned, it has been considered to have inverse relationship with firm value, because large boards suffer from coordination

problems (Jensen, 1993). On the other hand, more recent research claims that large boards can provide better monitoring (Lehn et al., 2009). Nevertheless, recent empirical results concerning the relation of board size with risk give ambiguous results (Pathan, 2009; Minton, Taillard and Williamson, 2010).

The presence of independent directors is also an important factor of the corporate governance literature, as it reinforces the reliability of firm reports on which investors rely heavily to make investment decisions. So, in order to reinforce the reliability of those reports, boards of directors have added more independent directors who are expected to make decisions that are the best for the firms, even if it means that it might go against the financial interest of the insiders. In order to induce greater transparency, independent board members have been either institutionalized or legislated, especially in the US, in a way that it has become an integral part of boards of directors and overall governance.

Regarding empirical literature findings are ambiguous. Adams and Mehran (2010) find that bank performance is unrelated to the outside director ratio. At the same time, empirical results have found that the proportion of outside directors is negatively related to risk (Pathan, 2009; Minton, Taillard and Williamson, 2010)). But more on empirical literature will be discussed on section 2.2.

2.1.2 Conflicts between bondholders and shareholders

The second type of agency conflicts within the Jensen and Meckling (1976) agency theory framework are those between bondholders and shareholders. Shareholders in leveraged firms have the motivation to undertake actions in order to reallocate firm wealth to themselves (e.g. share repurchases). In such a case, this is done at the expense of bondholders, since independently of the form that wealth transfer takes place, the expected cash flows of the firm decrease, leading to lower credit ratings and increased risk for bondholders.

A different aspect of the same problem is when shareholders have greater appetite for risk. In this case, shareholders may demand that managers make investments in riskier projects so as to satisfy their appetite. But then again is done at the expense of bondholders, because riskier projects mean increased variance of the firm's expected cash flows, again leading to lower credit ratings and increased risk for bondholders.

So, even though bondholder and shareholder interests are generally aligned with respect the first type of agency conflicts discussed previously, certain elements of corporate governance have an ambiguous impact on bondholders.

These elements are those that can give greater power to shareholders (or some groups of shareholders), so that they can exploit this power to obtain preferential treatment at the expense of other stakeholders.

To conclude, while it is beneficial for shareholders, certain elements of corporate governance can be detrimental to bondholders or form the opposite side of view elements of governance that weaken shareholder rights may actually be viewed positively from the bondholders.

2.1.3 Ownership structures and corporate governance

A key issue in corporate governance is whether large shareholders (or institutional shareholders or blockholders[1]) contribute to better corporate governance or not. And speaking in terms of principal-agent problems, the question is whether large shareholders mitigate or exacerbate agency problems.

2.1.3.1 Effects of large shareholders in corporate governance

The first aspect of the presence of large shareholders in firms is the potential positive impact in corporate governance due to their incentive for effective monitoring. Shleifer and Vishny (1986) explore a model where large shareholders have incentives to exert control over management. In this way large shareholding may be considered as a mechanism to achieve effective monitoring and thus have positive impact into the financial wellbeing of the firm. Thus, the agency problem is addressed by large shareholders in that they both have interest in profit maximization, and enough control of the firm to serve their interests (Shleifer and Vishny, 1997).

Jensen (1993) argues that as firm equity concentrates in institutional hands, free-rider problems of many individual shareholders can be resolved and institutional investors can exercise corporate control rights more effectively than otherwise. In a similar way, Shleifer and Vishny (1997) argue that large investors have the financial incentives to collect information and monitor management, thereby avoiding the free-rider problem. So, institutional shareholders have the financial incentives and independence to view firm management and policies in an unbiased way, and they have the voting power to put pressure on management if they observe self-serving behaviour.

Institutional shareholders are also expected to have better knowledge and expertise compared to small shareholders in the industries that they choose to

[1] Blockholders are shareholders who own at least 5% of a company's shares.

invest. Overall, institutional investors appear to be associated with better corporate decisions. With this respect, there are many studies that report that the existence of large shareholder ownership result in strong financial performance (McConnell and Servaes, 1990, Gedajlovic and Shapiro, 2002). Also, Ferreira and Matos (2008) show that institutional investors achieve better operating performance and lower capital expenditures.

Nevertheless, the theoretical relationship between large owners and firm value is sometimes ambiguous in literature. Thomsen et al. (2006) examine the relationship between blockholder ownership and firm value as a measure of performance. They find that high ownership is associated with lower subsequent firm value and accounting profitability in European countries, in contrast to contrary that holds in the market-based common law systems in the US and the UK. Denis and McConnell (2003) argue that blockholder ownership has a more positive effect on firm value in countries with lower levels of investor protection because it is more necessary to deal with managerial agency problems in these countries. Their findings are consistent with Thomsen et al. (2006), as they find that this is broadly consistent with a review of the empirical evidence outside the US and the UK.

Furthermore, very large ownership may lead to entrenchment of owner-managers that expropriate the wealth of minority shareholders (Shleifer and Vishny, 1997). But this aspect of the agency problem will be discussed in the following paragraph.

Therefore, all the above suggest that large shareholders are essential to a corporate governance system because they lead to more efficient monitoring of management and less managerial opportunistic behaviour, which benefits all stakeholders.

2.1.3.2 Conflicts between majority and minority shareholders

The second aspect of the presence of large shareholders in firms is the conflicts of interest between majority and minority shareholders. Even though large shareholders can contribute to efficient corporate governance, as explained above, they may arise situations of conflicts between the majority and minority shareholders in a firm (Thomsen et al., 2006). In terms of principal-agent problems, these conflicts fall into the category of principal-principal agency conflicts.

Principal–principal conflicts between majority and minority shareholders are due to reasons such as concentrated ownership, extensive family ownership and control, business group structures, and weak legal protection of minority shareholders (Young et al, 2008). In such circumstances, majority shareholders abuse their control of firm's ownership to exercise undue influence over management in order to secure benefits for themselves, which may be detrimental to minority shareholders. Thus, although large investors can be effective in solving the principal-agency problem, they may be also inefficient in redistributing wealth from other investors to themselves and consequently creating the principal-principal problem (Shleifer and Vishny, 1997). The causality of this phenomenon can by explained in cases of very large ownerships (above a certain level), the owners' portfolio risk increases with their exposure, which in turn may influence their risk taking behaviour (Bolton and von Thadden, 1998).

Thomsen et al. (2006), in their finding that high ownership is associated with lower 0 between majority and minority shareholders.

2.2 Empirical Studies on Corporate Governance

Corporate governance has been a wide field of research in financial economics, but also a wide range of other disciplines have contributed to the literature of corporate governance, such as law, accounting, marketing, management and organizational studies (Brown et al, 2011). With respect to financial economics, according to Shleifer and Vishny's (1997) review, "corporate governance deals with the ways in which suppliers of finance to corporations assure themselves of getting a return on their investment". Therefore, financial empirical studies on corporate governance have been concerned with the financial outcomes related to governance characteristics, mainly firm performance and cost of debt, namely from the shareholder's and bondholder's view respectively.

In the two subsections to follow, empirical studies related to corporate performance and cost of debt will be analysed, while on the third subsection research focusing solely on corporate governance of banks will be investigated. On the fourth subsection econometric techniques used in the literature are presented.

2.2.1 Corporate Governance and Firm Performance

The creation of corporate wealth –or firm performance- is probably what ultimately matters to firms, its shareholders and also scholars, so the effects of corporate governance on firm performance is also of equal importance. The literature on corporate governance and firm performance has been extensive and it has examined the way different governance attributes affect different performance measures.

Early research on corporate governance and firm performance has mainly dealt with attributes such as inside ownership (Morck et al., 1988; McConnell and Servaes, 1990). However, subsequent research took under consideration the existence of endogeneity and concluded that no causal relationship between insider ownership and firm performance could be found (Loderer and Martin, 1997; Cho, 1998). Specifically, Loderer and Martin (1997) initially found a significantly positive relationship between firm performance and inside ownership, but when they used a 2SLS regression, no relationship was present.

Director independence has also been examined with respect to firm financial performance (Block, 1999; Lin et al., 2003). Block (1999) finds that market reacts positively to the appointment of outside directors, under the condition that strong monitoring practices are not already in place. Yet again when considering endogeneity, recent studies provide no conclusive evidence for a relationship between board independence and firm performance. Bhagat and Black (2002) show that a firm with poor past performance is likely to have increased board independence, which is evidence of reverse causation. In a broader way, Bhagat and Bolton (2008) find that there exist endogenous relationships between firm performance and corporate governance, capital structure and ownership structure. So, while some studies show favourable market reactions to the appointment of outside directors, evidence that outside directors matters to long-term firm performance is ambiguous and contradictory (Brown et al., 2011).

Other attributes of corporate governance that have been examined are shareholder rights and block holder ownership. Gompers et al. (2003) construct a governance index called G-index and find that firms with strong shareholder rights yielded higher abnormal returns. Bhagat and Bolton (2008) also find that stronger shareholder rights are associated with better current and short-term firm performance. Lastly, Khan (2006) shows that as far as outside blockholders are concerned, what matters in firm performance is institutional investors.

2.2.2 Corporate Governance and Cost of Debt

Under the principal agent theory, strong corporate governance can not only reduce the probability of default, but also it can improve the availability of credible financial information necessary for accurate estimation of risk. In this way, information asymmetries between the firm and its lenders can be alleviated, thus reducing the firm's risk premium. So, governance can have a significant effect on firms' cost of debt, by being an important determinant of credit ratings.

Literature on firm credit ratings mostly considers as determinants of credit ratings firms' financial ratios and data, while ignoring the importance of corporate governance. However, there have been some studies considering as determinants of credit ratings firms' corporate governance.

Sengupta (1998) might be considered as one of the first studies to investigate effects of governance attributes on cost of debt. Even though his study was restricted to firms' disclosure quality ratings, he found an inverse relationship with the cost of debt financing.

Soon after the 2001-2 high profile corporate collapses, a series of studies on credit ratings begun investigating more on the relation between credit ratings and governance. Such studies were by Bhojraj and Sengupta (2003), Anderson et al. (2004) and Ashbaugh-Skaife et al. (2006) that in different ways showed that stronger monitoring power of the board over management is associated with higher credit ratings and a lower cost of debt for US firms.

Bhojraj and Sengupta (2003), using a sample of 1,005 industrial bond issues between 1991 and 1996, found that higher percentage of outside directors and greater institutional ownership lead to lower bond yields and higher ratings on firms' new debt issues. Other early papers that examine the influence of corporate governance on bond ratings, are those of Anderson et al. (2004), which using a sample of S&P 500 firms for the period of 1993–1998, found that the cost of debt is inversely related to board independence, board and audit committee size, and meeting frequency, and Cremers et al. (2007), which show that shareholder rights can have divergent and economically important effects on bondholders.

Ashbaugh-Skaife et al. (2006) extend the studies of Sengupta (1998) and Bhojraj and Sengupta (2003), evaluating a broader set of governance variables, thereby providing a more comprehensive analysis of the relevance of corporate governance from the perspective of bondholders. They provide evidence that credit ratings are higher for firms characterized by high accrual quality, earnings

timeliness and board independence, but are lower for firms with a large number blockholders, excessive CEO power and stockholder rights.

Another more recent study is that of Alali et al. (2012), in which by using the methodology of Ashbaugh-Skaife et al. (2006), they find that firms that have strong corporate governance have a significantly higher credit rating, and that this relationship is enhanced for smaller firms relative to larger firms. They additionally find that improving corporate governance is particularly beneficial for smaller firms than for larger firms.

Thus, the existing literature provides strong support that creditors take into account a firm's corporate governance practices in their assessment of the firm's risk.

2.2.3 Corporate Governance of Banks

Corporate governance of banks has been the topic of much recent academic work due to the inadequacies of bank governance exposed in global financial crisis in. What is noticeable is that all recent academic work examines the relationship between bank governance and in most cases risk measures and in few cases performance measures.

Laeven and Levin (2009), use several measures of bank risk and governance but focus primarily on z-score. They find that the presence of institutional investors increases the riskiness of the bank, which is consistent with the one of the findings of the subsequent work of Ellul and Yerramilli (2010).

Ellul and Yerramilli (2010) us multiple measures of riskiness, such as the standard deviation of stock returns and the mean implied volatility estimated using put options, controlling for a risk management index (RMI), that the authors have constructed, plus financial characteristics, institutional ownership and governance using the G-Index of Gompers et al. (2003). Their main finding is that banks with higher RMIs had lower risk measures of aggregate and downside risk, and higher stock returns. They also find banks with high RMI in the year 2006 (before the beginning of the financial crisis) had lower downside risk in the subsequent year when the financial crisis begun.

A whole host of papers find that different measures of bank risk are positive related with risk-taking incentives for bank managers (Mehran and Rosenberg, 2008; Ellul and Yerramilli, 2010; Suntheim, 2010). Mehran and Rosenberg (2008), using a sample of US banks, find that stock option compensation results to CEOs

to undertaking riskier investments. In a similar way, Suntheim (2010) examines the compensation practices using an international sample of banks and finds that there exists a positive relationship between bank risk and CEOs' risk taking incentives.

Another host of papers on bank governance and risk taking (?) concentrate on board characteristics (Pathan, 2009; Adams and Mehran, 2010; Erkens et al., 2012). Pathan (2009) use multitude proxies of bank risk (standard deviation of stock returns, beta and residual risk) in a sample of US banks and find that small bank boards affect positively risk taking attitude. Adams and Mehran (2010) examine the relationship between board structure and bank performance, and they find that the organizational structure of a bank is significantly related to bank board size, which is the reason why banking firms with larger boards do not underperform their peers. Erkens et al. (2012) measuring bank performance during the crisis period, find that independent boards and institutional ownership are negatively related to stock returns.

Lastly, Mehran et al. (2011) offer a literature review in recent academic work on bank governance, in order to analyse the flaws of the banking system that were exposed by the financial crisis of 2007-8. They examine four topics of bank governance: executive compensation, boards, risk management and market discipline, while discussing promising solutions in each of the four topics that the authors showcase.

2.2.4 Econometric techniques used in Literature

The general model found in the literature which examines credit ratings as a function of corporate governance attributes and firm characteristics, is the following:

$$\text{Credit Rating} = f(\text{corporate governance attributes}, f\text{irm characteristics})$$

So, apart from the corporate governance attributes, a number of additional explanatory variables are included. The variables determining corporate bond ratings found in the literature, among others include firm size, ratios of debt-to-assets, return-on-assets, etc (Bhojraj and Sengupta, 2003; Ashbaugh-Skaife et al., 2006; Alali et al., 2012).

As far as the statistical methods applied in literature, when the dependent variable is firm performance or risk measures, we find that ordinary least squares

(OLS) is used. Howevee, when the dependent variable is credit ratings, we find either ordered logit or ordered probit models (see Table 1) being used.

Ordered logit is mostly found in most recent studies (Ashbaugh-Skaife et al., 2006; Alali et al., 2012). Intuitively this model is more appropriate than ordered probit due to its a priori assumptions. It recognises the ordered structure of the ratings and it can also adjust to the specific features of the rating scale. Whilst the ordered probit model assumes a constant influence of variables across all rating categories.

One last point that should be emphasized is the issue of endogeneity addressed in the previous subsections. The above relationship treats governance attributes as being exogenously determined. In this case having found a positive relationship between firm performance and governance attributes, one can conclude improving some governance attributes will improve firm performance. But this is not the case because causality may run in both directions, i.e. firms with strong governance experience strong performance but also firms with strong performance choose strong management. The problem of endogeneity can be addressed by alternative specifications as robustness checks.

Table 2.1 presents a brief list of the models linking attributes of corporate governance and metrics od hare performance.

Table 2.1: Econometric Techniques used in Corporate Governance Literature

Authors	**Regression Technique Used**	**Treatment of Endogeneity**
Alali et al. (2012)	Ordered Logit	Simultaneous equation approach
Ashbaugh-Skaife et al. (2006)	Ordered Logit / Logistic Regression	Simultaneous equation approach
Bhojraj and Sengupta (2003)	Ordered probit	Simultaneous equation approach using 3SLS
Cremers et al. (2007)	Ordered probit	-

2.3 Credit Rating Agencies and Corporate Governance

The credit rating that a credit rating agency (CRA) issues for a firm reflects the agency's view of the overall creditworthiness of the firm and its ability to meet its financial obligations (Standard & Poor's, 2002). Within this context, CRAs have been concerned with corporate governance because weak governance can impair a firm's financial position and disturb its ability to meet its financial obligations, as in the case of the 2001-2 high profile corporate collapses. The following sections will present the approach of corporate governance that has been followed by the The Big Three CRAs, i.e. Standard & Poor's (S&P), Moody's, and Fitch Ratings.

2.3.1 Standard & Poor's Corporate Governance Practices

Standard & Poor's (S&P) was the first CRA to begin the development of corporate governance benchmark in early 1998. In 2002, S&P formed a dedicated unit called Governance Services, which developed a comprehensive framework for evaluating corporate governance for firms in emerging markets (Standard & Poor, 2002). This framework was named Corporate Governance Score (CGS) and it reflected S&P assessment of a firm's corporate governance practices and policies with an emphasis on the shareholders' interests. CGS framework was based on four governance components: (1) ownership structure and influence, (2) financial stakeholders rights and relations, (3) financial transparency and disclosure, and (4) board structure and processes. It should be made clear that even though CGS scores were assigned on a scale from 1 (lowest) to 10 (highest), they were not credit ratings.

S&P CGS was improved in the years following its initial launch (see also Standard & Poor, 2004), until 2007, when the CGS methodology of stand-alone governance analysis underwent a major overhaul. A new framework named GAMMA methodology was introduced in 2008, likewise for firms in emerging markets and it included a firm's enterprise risk management and strategy-making processes. The word GAMMA is coming from the words Governance, Accountability, Management Metrics and Analysis, and the new methodology was comprised offour new governance components: (1) Ownership Influences, (2) Shareholder Rights, (3) Transparency, Audit, and Enterprise Risk Management, and (4) Board Effectiveness, Strategic Process, and Compensation practices. This new methodology again used a numeric scale from 1 (lowest) to 10 (highest), but its breakthrough was that it recognized the importance of stakeholders' rights

beyond the rights of the shareholders, by addressing the interests of both creditors and shareholders. This development took place because of the increasing debate that corporate governance should include a firm's other stakeholders such as creditors, employees, customers, and the local community.

We should note that while S&P provides the aforementioned stand-alone governance score, i.e. non-financial-risk assessment or assessment of corporate-governance risk, its credit ratings include both financial and non-financial factors, and in particular management and corporate governance attributes.

2.3.2 Moody's Corporate Governance Practices

In 2002, Moody's established a new corporate governance section in order to conduct Corporate Governance Assessments for selected major North American debt issuers. These Corporate Governance Assessments were constructed based on public information and they were supplemented with discussions with firms' management. A distinct characteristic of these assessments was that evaluation of governance practices does not result in a score or rating. Instead, Moody's provided "a textual opinion on the quality of governance."

A few years later, Moody's published an assessment report (Moody's, 2006), given its up to this time accumulated experience, where it gave details on the categorization of the impact of a firm's governance. The categorization was in a scale of 5 as follows: Governance is a credit strength, Governance is relatively strong, Governance is neutral, Governance is relatively weak and Governance is a credit weakness.

2.3.3 Fitch Ratings' Corporate Governance Practices

In 2004, Fitch Ratings (FR) published a special report titled "Evaluating Corporate Governance: The Bondholders' Perspective" (Fitch Ratings, 2004). In their special report, FR publicised their approach to incorporate corporate governance into their overall credit rating process, even though, according to FR, they had always considered corporate governance aspects in their ratings. The core elements of corporate governance considered by FR in their special report in 2004 were: (1) Independent and effective board of directors, (2) Oversight of related-party transactions, (3) Audit process integrity, and (4) Reasonable and performance-based management compensation.

FR corporate governance methodology was developed in the years to follow and nowadays FR evaluates governance matters on two levels: country-specific

and issuer-specific (Fitch Ratings, 2012). The country-specific governance part assesses the jurisdictional environment of a firm's country of incorporation, whereas the issuer-specific part focuses on the characteristics shaped by the industry in which the firm operates and the relationships among its stakeholders. In detail, the core elements of issuer-specific part are (1) board effectiveness, (2) management effectiveness, (3) transparency of financial information, and (4) related-party transactions.

2.4 Policy Implications for Governance of Banks

Bank governance has not only been the topic of recent academic work, but it has also been the topic of policy discussion. Besides the numerous reports that have been issued for the causes of the financial crisis, such as the aforementioned report of F.C.I.C. and the Levin-Coburn Report of the U.S. Senate, there have been reports such as the Walker Report (2009) and the report of the Committee of European Banking Supervisors (2010) analyzing the failure of bank governance. Furthermore, supervisory authorities around the world have taken actions to engage dialogue on risk management practices in banking. The most prominent examples are the Basel Committee on Banking Supervision and the Senior Supervisors Group, which will be discussed in the next two sections.

2.4.1 Basel Committee on Banking Supervision

The Basel Committee on Banking Supervision is a special committee of the Bank of International Settlements which acts as forum for the cooperation of its member countries on banking supervisory matters. The Committee's objective is to enhance the understanding of key supervisory issues in banking and to improve banking supervision around the globe.

The Committee has been issuing principles for enhancing corporate governance since 1999. The latest revised principles, which were published in July 2015, stress the importance of risk governance as part of a bank's overall corporate governance framework and promotes the value of strong boards and board committees together with effective control functions.

The revised principles have five key points which include the following: (1) enhanced role of board of directors in overseeing the implementation of effective risk management systems, (2) emphasis on the board's collective competence and individual board members sufficient time for their duties, (3) enhanced

guidance on risk governance of the bank's three lines of defense[2] and establishment of a sound risk culture, (4) guidance in evaluating the selection processes of board members and senior management; (5) reevaluation of compensation and incentive structure of senior management in order to convey acceptable risk-taking behavior and reinforce the bank's operating and risk culture.

2.4.2 Senior Supervisors Group

According to its mission statement, the Senior Supervisors Group (SSG) is also a forum for senior representatives of financial supervisory authorities of the participating countries and institutions[3], with scope of engaging in dialogue on risk management practices, governance, and other issues concerning complex, globally-active financial institutions.

Since its establishment, SSG uses its network to share information and facts on supervisory issues and approaches, while engaging with the financial industry to develop a better understanding of the challenges and the risks that important institutions faced systematically.

Two of the most prominent reports that SSG has published (Senior Supervisors Group, 2008, 2009) are concerned commenting extensively on the conclusions on risk management functions before the crisis years, 2007 and 2008. SSG's reports have been useful not only to policymakers but also to academics. Ellul and Yerramilli (2010) in their analysis of U.S. bank holding companies risk management practices, conduct their analysis based on the main finding of SSG's report in 2008, which said that institutions with strong risk management functions identified risks and started taking corrective actions as early as in 2006.

[2] Business units, risk management teams, and internal audit and control functions.
[3] As of today, 10 countries and institutions participate in SSG.

3. Bank Governance and Credit Ratings

3.1 Introduction

This essay aims to investigate whether, at international level, banks with strong corporate governance benefit from higher credit ratings. We are interested to distinguish the key determinants of corporate governance in bank ratings and how they differ for each rating agency. Also, we seek similar empirical evidence when bank enjoy strong country institutional characteristics. Our empirical work concludes by examining the evolution in the relationship of bank governance and credit ratings before, and after the global financial crisis. Following the review of literature on fundamental theories, empirical research and market practices, this section will focus on examining the research questions developed in section 1.3 through empirical analysis of data and discussion of results.

3.2 Empirical Strategy

In Section 2.2.4 we shortly discussed the econometric techniques used in literature and indicated that ordered logit is mostly found in studies where the dependent variable is credit ratings, as it is more appropriate due to its a priori assumptions.

To investigate the relationship between corporate governance and bank credit ratings, we estimate an ordered logit model where bank ratings are modelled as a function of financial explanatory variables and governance explanatory variables. The model is:

$$R_{i,t} = \begin{cases} 17 & \text{if } Z_{it} \in [\mu_8, \infty) \\ 16 & \text{if } Z_{it} \in [\mu_7, \mu_8) \\ 15 & \text{if } Z_{it} \in [\mu_6, \mu_7) \\ \vdots & \\ 3 & \text{if } Z_{it} \in [\mu_2, \mu_3) \\ 2 & \text{if } Z_{it} \in [\mu_1, \mu_2) \\ 1 & \text{if } Z_{it} \in (-\infty, \mu_1) \end{cases} \quad (1)$$

$$Z_{i,t} = \beta' X_{it} + \gamma' Y_{it} + \varepsilon_{it} \quad (2)$$

where R_{it} denotes the credit rating of bank *i* at year *t* according to the latent variable $Z_{i,t}$ and the partition points μ_i that distinguish each rating category. β is the vector of slope coefficients for the matrix X_{it} of the financial explanatory variables, and γ is the vector of slope coefficients for the matrix Y_{it} of the governance explanatory variables. All explanatory variables are year-end variables, but the credit ratings are observed at the end of each year-end. This is because we make the assumption that CRAs must first receive the publicly available financial and governance information for a bank and then decide for the bank's credit rating. For example, year-end financials of 2010 are announced from early February till mid-March of 2011, while governance data are available at the end of 2010, and accordingly the credit rating is observed at the end of the first quarter of 2011, when we assume that the CRA has made its decision. This approach is similar to Baghai, Servaes, and Tamayo (2014) that consider the first rating available three months after the fiscal year-end and match this rating with the fiscal year-end financial statement data.

3.3 Sample and variables

Consistent with the aim of this essay, data for the analysis are compiled by the following two sources: BoardEx database and Bankscope databases. BoardEx is one of the most comprehensive databases for business intelligence that among other contains data for management of firms from all over the world, even though extensive coverage is for North American countries and Europe. The years of coverage on BoardEx start at 1999 and all observations are yearly -most of the times for the end of year-. So, our main source of governance data is BoardEx and the biographical information on most board members and senior executives for financial institutions around the world. Out of this information, we use all relevant corporate governance attributes for our analysis. The time period for which we have at our disposal data from BoardEx is from 1999 to 2014. The total number of banks that governance data are available in BoardEx are presented in Table 3.1.

Table 3.1: BoardEx Database Sample

World Region	Number of Banks
Europe	222
North America	927
Rest of the World	256
Total	*1,405*

Despite high numbers from each world region, the useable reduces significantly, as for example most of the US banks that are in the North Amerca (NA) region are small banks that are not rated. Also, Bankscope database, which is our second source, has information on roughly 22,500 banks (according to their website 32,000 banks) around the world. The information we use from BaskScope database is the credit ratings of the banks that will be included in our analysis and banks' financial characteristics as the control variables to surrogate bank's default risk. In order to have homogeneity in our sample, we apply a number of selection criteria in Bankscope. Those criteria are bank's specialization and whether the bank considered is the ultimate owner in the ownership structure. For the specialization criterion we choose from Bankscope only values of Commercial Banks, Savings Banks, Cooperative Banks and Bank Holding & Holding Companies (BH&HCs), so as to maintain homogeneity in our sample by concentrating broadly on commercial banks (i.e. excluding investment banks, custodian banks, etc), which play have a fundamental role in the economy. The ultimate owner criterion is to avoid double-counting ratings of banks that are junior within a single ownership structure (e.g. while Citigroup Inc is included as the ultimate holder in the Group, all its subsidiaries are excluded).

When we combine the available data from BoardEx with Bankscope data, the number of banks reduces to a total of 243 banks from the around the world as presented Table 3. In the end, we have an unbalanced panel as displayed in the last column of Table 3.2.

Table 3.2: Combined Final Sample

World Region	Number of Banks	Bank-year observations
Europe	117	1,069
North America	85	1,048
Rest of the World	41	241
Total	*243*	*2,358*

3.3.1 Bank Credit Ratings and Financial Variables

The credit ratings of each CRA we choose to use in our analysis are the long-term issuer ratings which are used in all related literature for bank ratings (Hau, Langfield and Marques-Ibanez, 2012; Van Laere, Vantieghem and Baesens, 2012; Salvador, Pastor and Fernandez de Guevara, 2014). The long-term issuer ratings are the primary issuer ratings of each CRA and in particular for Fitch we use their the long-term issuer default rating (IDR), for Moody's we use their long-term Issuer rating (foreign) and for Standard and Poor's we use their foreign currency long-term Issuer Credit Rating (ICR). All credit ratings obtained are transformed from their letter form into a numerical value that corresponds to an ordinal scale. In all related literature for credit ratings we find studies that use ordinal scales from 4 categories to 17 categories. E.g. Blume, Lim, and Mackinlay (1998) use an ordinal scale of 4 categories, Salvador, Fernández de Guevara and Pastor (2018) use a numerical scale of 11 categories, whereas Van Laere, Vantieghem and Baesens (2012) use an ordinal scale of 17 categories. Given the size of each CRA's subsample, we choose to also use an ordinal scale of 17 categories, according to Table 3.3.

In Table 3.4 we present the basic summary statistics for the bank credit ratings of our combined sample, by each CRA for the world sample and for each world region separately. The period for the summary statistics are for the period from 1999 to 2014, when governance bank data is available from BoardEx (i.e. we disregard available credit ratings before 1999 and after 2014). Fitch on average assigns lower ratings compared to Moody's and S&P, while S&P has the lowest standard deviation. In the second part of Table 3.4 we present the basic summary statistics for the bank credit ratings of the three CRAs, but for the period before and after the global financial crisis, i.e. from 1999 to 2008 and from 2009 to 2014.It is interesting that all three CRAs' average bank ratings decrease by

Table 3.3: Rating Transformation Table

Fitch	Rating Scale Number	Moody's	Rating Scale Number	S&P	Rating Scale Number
AAA	17	Aaa	17	AAA	17
AA+	16	Aa1	16	AA+	16
AA	15	Aa2	15	AA	15
AA-	14	Aa3	14	AA-	14
A+	13	A1	13	A+	13
A	12	A2	12	A	12
A-	11	A3	11	A-	11
BBB+	10	Baa1	10	BBB+	10
BBB	9	Baa2	9	BBB	9
BBB-	8	Baa3	8	BBB-	8
BB+	7	Ba1	7	BB+	7
BB	6	Ba2	6	BB	6
BB-	5	Ba3	5	BB-	5
B+	4	B1	4	B+	4
B	3	B2	3	B	3
B-	2	B3	2	B-	2
CCC+	1	Caa1	1	CCC+	1
CCC	1	Caa2	1	CCC	1
CCC-	1	Caa3	1	CCC-	1
CC	1	Ca	1	CC	1
C	1	C	1	C	1
RD	1			R	1
D	1			SD	1
				D	1

more than one notch while at the same time their volatility increases. Moody's has the greatest drop of 1.91 notches in their average bank ratings, then S&P follows with 1.56 notches and then Fitch with 1.14 notches.

Table 3.4a: Summary Statistics for Bank Credit Ratings

	Fitch			Moody's			S&P		
	Mean	Std Dev	Obs	Mean	Std Dev	Obs	Mean	Std Dev	Obs
Full Sample	9.48	3.17	2,371	9.85	3.40	2,035	9.49	2.90	1,928
Europe	9.58	3.30	1,178	9.72	3.71	1,065	9.59	3.33	855
NA	9.81	2.77	911	10.83	2.64	649	9.70	2.40	767
RoW	7.97	3.43	282	8.33	3.06	321	8.67	2.60	306

Table 3.4b: Summary Statistics for Bank Credit Ratings for different periods

	Fitch			Moody's			S&P		
	Mean	Std Dev	Obs	Mean	Std Dev	Obs	Mean	Std Dev	Obs
1999-2008	9.94	3.08	1,419	10.71	3.01	1,124	10.16	2.58	1,099
2009-2014	8.80	3.20	952	8.80	3.55	911	8.60	3.06	829

As far as the financial explanatory variables are concerned, we choose to use five financial variables that are mostly found in related literature (e.g. Ellul and Yerramilli,

2010, Hau, Langfield and Marques-Ibanez, 2012, Van Laere, Vantieghem and Baesens, 2012). Those financial characteristic variables cover bank size, profitability, leverage, asset structure and funding structure. For bank size we the natural log of total assets, for profitability we choose Return on Average Assets (ROAA), for leverage we choose Total Assets divided by Equity, for asset structure is measured by both Net Loans divided by Total Assets, and for funding structure we choose short-term funding divided by total assets. In Table 3.5 we present the basic summary statistics for the financial explanatory variables.

Apart from the financial explanatory variables described above which relate to the intrinsic risk of a bank, we need to an explanatory variable for the external support element. Following Van Laere, Vantieghem and Baesens (2012) and Salvador, Fernández de Guevara and Pastor (2018), we choose to add as an explanatory variable the sovereign credit rating to proxy, not only the external support as considered by the CRAs but also the economic environment of the bank. So, we choose the sovereign credit rating by the same CRAs and the equivalent time periods (i.e. if we have a bank rating for a bank at period *t* by Fitch,

Table 3.5: Summary Statistics for Financial Variables

	Full Sample			Europe			NA		
	Mean	Std Dev	Obs	Mean	Std Dev	Obs	Mean	Std Dev	Obs
Bank size	7.52	.78	3,517	7.70	0.80	1,662	7.36	0.74	1,224
Profitability	0.78	4.53	3,514	0.55	6.22	1,659	0.85	2.12	1,224
Leverage	23.07	565.2	3,516	37.10	818.32	1,661	11.75	11.74	1,224
Asset structure	57.47	16.63	3,512	57.14	16.79	1,657	61.23	15.50	1,224
Funding structure	165.5	949.9	3,495	204.40	1,383.2	1,643	132.08	67.48	1,221

i.e. 3 months after year end, we obtain the bank's country credit rating again for period *t*, for the year end).

Equivalently, we use the same ordinal scale of 17 categories to transform sovereign ratings from their letter form into a numerical value, according to Table 3.3. In Table 3.6 we present the basic summary statistics for the sovereign credit ratings.

Table 3.6: **Summary Statistics for Sovereign Credit Ratings**

	Fitch			Moody's			S&P		
	Mean	Std Dev	Obs	Mean	Std Dev	Obs	Mean	Std Dev	Obs
Full Sample	13.11	4.11	3,471	13.91	3.87	2,931	13.08	4.05	3,687
Europe	12.40	4.17	1,699	13.22	4.04	1,237	12.48	4.09	1,800
NA	15.98	0.13	1,268	16.00	0.00	1,339	15.76	0.43	1,360
RoW	8.31	3.37	504	8.46	4.32	355	8.20	3.73	527

3.3.2 Governance variables

The central idea of our hypothesis is that governance features impact credit ratings by controlling agency costs that result from conflicts between managers and all external stakeholders as well as between bondholders and shareholders. Most studies on corporate governance focus on board independence instead of a broad set of attributes to cover stakeholders' claims to firms' resources (e.g. Sengupta, 1998; Bhojraj and Sengupta, 2003). Our available governance variables from BoardEx cover the first aspect of governance, i.e. between managers and all external stakeholders, but do not cover the conflicts as between

bondholders and shareholders. Ashbaugh-Skaife et al. (2006) use Standard & Poor's framework (Standard & Poor, 2002) to identify which governance attributes affect credit ratings. This framework consists four components of governance: Ownership structure and influence, financial stakeholder rights and relations, financial transparency, and board structure and processes. Out of this framework, we cover the third and fourth components of financial transparency, and board structure and processes. In Table 3.7 we present all the governance variables available from Bankscope.

The first component of ownership structure and influence requires variables that show the concentration in ownership. Ownership concentration shows how shareholders are allowed to exercise influence on management so as to secure their own interests at the expense of minority shareholders or debtholders. Other variables could be the ownership percentage of institutional investors and the percentage of shares owned by officers or directors (Ashbaugh-Skaife et al., 2006). The second component of financial stakeholder rights and relations ideally requires a governance index such as the aforementioned G-index by Gompers et al. (2003). But as already explained, BoardEx governance data do cover neither the first component nor the second. It should also be noted that even though Bankscope has ownership data for banks, those data concern only current ownership. Similarly, FitchConnect, which is a financial database that also contains information for bank around the world, similarly has only current ownership data for banks. The third component of financial transparency requires variables that portray the information asymmetry between the bank and its bondholders and shareholders. Unfortunately, there are no such data available in BoardEx for the transparency of the banks' financial reporting, or even in its prudential reporting.

The fourth component of board structure and processes concerns issues such as the size of the board and it's composition, the existence and structure of committees, competency of board members, the existence of independent directors on the board and on committees and remuneration structure of board members. BoardEx database contains many variables that will allow us to evaluate the relationship of the fourth component and bank ratings. The variables available from BoardEx database relevant to board structure and processes are presented in Table 3.7. A note should be made that the last variable named CRO, which is not a variable directly extracted in BoardEx database, but a variable created from the individual role variable for board members in BoardEx. So, in this

way we have constructed a variable to denote the presence of a director in the board, whose title or role is either Chief Risk Officer or similar (e.g. Head of Risk Management, Risk Management/Control, etc). Similar to Ellul and Yerramilli (2010) we believe that the presence of a chief risk officer is interrelated with the risk management function and we shall examine how it overall affects bank ratings. Additionally, the variables in the last rows of Table 3.7 regarding the Audit, Remuneration/Compensation and Nomination Committees are expected to contribute to a bank's overall risk management function.

Table 3.7a: Governance Variables Definitions

Variable	Definition
#Brd_Mbrs	Total number of the members of the bank's board of directors.
#Brd_NEDs	Number of non-executive directors (NEDs) in the bank's board of directors.
%NEDs	Percentage of non-executive directors (NEDs) in the bank's board of directors (i.e. #Brd_NEDs/#Brd_Mbrs).
#BRD_IndNEDs	Number of independent non-executive directors (NEDs) in the bank's board of directors, i.e. members of the board who are not an employee of the bank.
%IndNEDs	Percentage of independent non-executive directors (NEDs) in the bank's board of directors (i.e. #Brd_IndNEDs/#Brd_Mbrs).
Chairman_CEO	CEO and Chairman Roles are combined on the Board (1-Yes, 0 - No).
AvgTimeEDs	Average time in years that Executive Directors (EDs) have been in their current role.
AvgTimeNEDs	Average time in years that NEDs have been in their current role.
AvgBoardTdNEDs	Sums all the quoted boards that NEDs have sat on to-date then divided by the number of NEDs.
AvgBoardCurEDs	Sums all the quoted boards that Eds currently sit on and is then divided by the number of Eds.
AvgAgeEDs	Average age of Eds.
AvgAgeNEDs	Average age of NEDs.
AvgEduEDs	Total qualifications gained by EDs divided by the number of EDs, where all qualifications have a rating of one.
AvgEduNEDs	Total qualifications gained by NEDs divided by the number of NEDs, where all qualifications have a rating of one.
%GendEDs	Percentage of male sex of EDs.
%GendNEDs	Percentage of male sex of NEDs.

ExChairBoard	Executive Chairman present on Board or Combined role of CEO & Chairman is present (1- Yes, 0 - No).
#IndNEDsPastCFO/FD	Number of independent NEDs with past CFO/FD role.
AuditSize	Number of members of the Audit Committee
RenumSize	Number of members of the Remuneration/Compensation Committee
NominSize	Number of members of the Nomination Committee
#IndNEDsAudit	Number of independent non-executive directors (NEDs) in the Audit Committee
%IndNEDsAudit	Percentage of independent non-executive directors (NEDs) in the Audit Committee
#IndNEDsRenum	Number of independent non-executive directors (NEDs) in the Remuneration/Compensation Committee
%IndNEDsRenum	Percentage of independent non-executive directors (NEDs) in the Remuneration/Compensation Committee
#IndNEDsNomin	Number of independent non-executive directors (NEDs) in the Nomination Committee
%IndNEDsNomin	Percentage of independent non-executive directors (NEDs) in the Nomination Committee
CRO	Presence of a director in the board, whose title/role is either Chief Risk Officer or similar (1- Yes, 0 - No).

In Table 3.7b we present the basic summary statistics for the all the governance variables. Similar as above, in the last two columns, we can see for each governance variable the mean value for the period before and after the global financial crisis, i.e. from 1999 to 2008 and from 2009 to 2014. The most interesting difference in the mean values before and after the global financial crisis, is the CRO variable for which we observe a quadruple mean value in the after period compared to the before the financial crisis period.

Table 3.7b: Summary Statistics for Governance Variables

	Full sample		1999-2008	2009-2014
Variable	Mean	Std Dev	Mean	Mean
#Brd_Mbrs	14.80	5.12	15.51	14.03
#Brd_NEDs	12.00	4.26	12.63	11.32
%NEDs	81.56	0.13	81.61	81.52
#BRD_IndNEDs	7.66	4.70	8.02	7.27
%IndNEDs	54.13	0.30	54.84	53.36
Chairman_CEO	0.006	0.077	0.007	0.004
AvgTimeEDs	4.59	3.75	4.58	4.61
AvgTimeNEDs	5.78	3.38	5.95	5.60
AvgBoardTdNEDs	2.64	1.48	2.63	2.65
AvgBoardCurEDs	1.54	0.88	1.59	1.48
AvgAgeEDs	55.76	6.46	55.47	56.07
AvgAgeNEDs	59.86	4.99	59.55	60.19
AvgEduEDs	1.99	3.08	1.92	2.06
AvgEduNEDs	1.69	0.67	1.61	1.79
%GendEDs	97.30	8.97	97.97	96.57
%GendNEDs	86.67	11.43	88.83	84.34
ExChairBoard	0.56	0.50	0.65	0.46
#IndNEDsPastCFO/FD	0.54	0.91	0.43	0.67
AuditSize	3.830	2.08	3.71	3.97
RenumSize	3.37	2.16	3.29	3.46
NominSize	3.04	2.78	2.80	3.30
#IndNEDsAudit	3.03	2.14	3.02	3.03
%IndNEDsAudit	67.51	0.41	68.15	66.82
#IndNEDsRenum	2.68	2.05	2.69	2.68
%IndNEDsRenum	63.37	0.42	63.31	63.43
#IndNEDsNomin	2.33	2.40	2.30	2.35
%IndNEDsNomin	49.86	0.45	48.78	51.03
CRO	0.046	0.21	0.019	0.075

3.3.3 Country Institutional Characteristics

The last group of explanatory variables is for assessing how country institutional characteristics affect bank ratings. For this purpose, we use the International Country Risk Guide by PRS Group, which is a rating system that comprises a group of variables in three subcategories of risk: political, economic, and financial risk ratings. We use their political risk index which has 12 components: Government Stability, Socioeconomic Conditions, Investment Profile, Internal Conflict, External Conflict, Corruption, Military in Politics, Religion in Politics, Law and Order, Ethnic Tensions, Democratic Accountability and Bureaucracy Quality. Some of the components have subcomponents, e.g. Government Stability's subcomponents are Government Unity, Legislative Strength, and Popular Support, and components have scores of up to 12, 6 or 4 points. Data are yearly and they are available from 1984 for more than 140 countries around the world. So, for our sample of banks, there are available data for all banks' countries.

For the purpose of our analysis we choose to the following components of the political risk index: Government Stability (max 12 points), Socioeconomic Conditions (max 12 points), Investment Profile (max 12 points), Corruption (max 6 points), Law and Order (max 6 points), Democratic Accountability (max 6 points) and Bureaucracy Quality (max 4 points). So, we believe that all the selected components are relevant to a country's institutional characteristics and can help us in our analysis. Short description for each of the selected component is given below:

Government Stability	Government's ability to carry out its declared programs, and its ability to stay in office.
Socioeconomic Conditions	Socioeconomic pressures at work in society that could constrain government action or fuel social dissatisfaction.
Investment Profile	Assessment of Contract Viability/Expropriation, Profits Repatriation, and Payment Delays that affect the risk to investment.
Corruption	Assessment of corruption within the political system.
Law and Order	The strength and impartiality of the legal system, and the assessment ofpopular observance of the law.
Democratic Accountability	Government's responsiveness to its people.
Bureaucracy Quality	Institutional strength and quality of the country's bureaucracy.
Source: PRS Group	

3.4 Empirical Results

In this section we proceed with the empirical results. First, we perform Principal Component Analysis for the governance variables in order to simplify our analysis and explore the existence of a relationship between bank ratings and bank governance. Next, we propose a common base model for all three CRAs with a selection of the available governance variables to examine the relationship between bank ratings and bank governance. Next, we incorporate in our model country institutional characteristics to examine how they affect bank credit ratings, and in the last subsection we proceed with structural break tests to examine if there is difference in the relationship of bank governance and bank credit ratings before and after the global financial crisis.

3.4.1 PCA Analysis for Governance Variables

Given the number of our available governance variables, we initially chose to use Principal Component Analysis (PCA) so as to reduce the dimensionality of our data set and also to identify a smaller number of variables (component scores) for the purpose of our analysis. We can then use the component scores in the model of equations (1) and (2) as to answer the question whether corporate governance affect bank credit ratings. In Table 3.8 we present the results of our PCA analysis for all our 28 governance variables. Interestingly enough 28 components, i.e. the same number with the variables, are extracted from the PCA analysis and the first eight have eigenvalues above 1. Due to the relatively large number of components with eigenvalues above 1, we chose only to keep the first five for our analysis, which have a cumulative percentage of explained variance above 0.55.

In Table 3.9 we estimate the model of equations (1) and (2), where matrix Y_{it} instead contains the first five principal components from Table 3.8. The coefficients of almost all financial explanatory are uniformly statistically significant and have the same expected signs across CRAs. Log of Assets and R.O.A.A. are highly significant across all three CRAs with positive signs as expected. ST Funding/Total Assets is also highly significant across all three CRAs has a negative sign as expected, while the other two financial ratios have low statistical significance. Country Rating coefficients have, again as expected, a positive sign and high significance levels for all three CRAs,

Table 3.8: Principal Component Analysis for Governance Variables

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	7.708	5.229	0.275	0.275
Comp2	2.479	0.251	0.089	0.364
Comp3	2.229	0.509	0.080	0.444
Comp4	1.720	0.206	0.061	0.505
Comp5	1.514	0.107	0.054	0.559
Comp6	1.407	0.228	0.050	0.609
Comp7	1,179	0.175	0.042	0.651
Comp8	1.004	0.023	0.036	0.687
Comp9	0.981	0.055	0.035	0.722
Comp10	0.926	0.117	0.033	0.755
Comp11	0.809	0.038	0.029	0.784
Comp12	0.771	0.013	0.028	0.812
Comp13	0.758	0.033	0.027	0.839
Comp14	0.725	0.069	0.026	0.865
Comp15	0.656	0.041	0.023	0.888
Comp16	0.615	0.055	0.022	0.910
Comp17	0.560	0.106	0.020	0.930
Comp18	0.454	0.122	0.016	0.946
Comp19	0.332	0.008	0.012	0.958
Comp20	0.324	0.060	0.012	0.970
Comp21	0.265	0.072	0.009	0.979
Comp22	0.192	0.049	0.007	0.986
Comp23	0.143	0.029	0.005	0.991
Comp24	0.114	0.066	0.004	0.995
Comp25	0.048	0.011	0.002	0.997
Comp26	0.038	0.003	0.001	0.998
Comp27	0.035	0.023	0.001	1.000
Comp28	0.012	.	0.000	1.000

Table 3.9: Estimation results for full samples with principal components

Estimation results for the ordered logit model of the full samples. The dependent variable is equivalently Fitch, Moody's and S&P long-term issuer ratings as defined in subsection 3.3.1, while the financial explanatory variables are also defined in subsection 3.3.1 and instead of governance variables we use the first five principal components from Table 3.8. Standard errors are calculated using cluster-correlated robust estimate of variance at the bank level, and the asterisks *, **, and *** next to the coefficients values respectively correspond to significance levels 10%, 5% and 1%.

Variables	**Fitch**		**Moody's**		**S&P**	
Financial Variables	Coeff	Z-stat	Coeff	Z-stat	Coeff	Z-stat
LN of Total Assets	2.49***	10.90	1.74***	7.79	2.22***	7.43
ROAA	0.41***	4.46	0.34***	3.78	0.55***	4.45
Total Assets/Equity	-0.0002	-0.19	0.02	1.51	0.02*	1.84
Net Loans/Total Assets	-0.0004	-0.03	0.01	0.96	0.002	0.13
ST Funding/Total Assets	-0.01***	-3.96	-0.0000***	-3.42	-0.01***	-3.55
Country Rating	0.60***	11.21	0.57***	11.40	0.65***	11.29
Principal Comp.						
Principal Component 1	-0.18***	-3.28	-0.06	-1.03	-0.24***	-4.02
Principal Component 2	0.16*	1.90	0.08	0.91	0.20*	1.76
Principal Component 3	0.16**	2.32	0.08	1.18	0.12	1.50
Principal Component 4	-0.11	-1.42	-0.08	-1.09	0.04	0.43
Principal Component 5	0.23**	2.43	0.20***	2.70	0.16	1.60
Number of Obs	1,733		1,268		1,522	
Pseudo R^2	0.2634		0.2170		0.2539	
Cluster of Banks	191		167		167	

The five principal components are less interpretable and do not have any real meaning since they are constructed as linear combinations of the initial governance variables. So, we cannot infer any meaning either from their coefficient levels or the coefficients signs. However, we can infer from their significance levels that governance variables add to the explanatory power of the model for all three CRAs' bank ratings. In order to confirm this, we perform an LR test to assess the difference in fit comparing the fit of the restricted model, i.e. the same model presented in Table 3.9 but without the five principal components,

against the full model with the principal components in Table 3.9, for each CRA separately. Results of the LR test are presented in Table 3.10.

Table 3.10: LR test for the PCA model against the restricted model

	Fitch	Moody's	S&P
LR χ^2	170.17	45.42	177.40
Prob > χ^2	0.0000	0.0000	0.0000

The results in Table 3.10 indicate that for all three CRAs the full model as in Table 3.9 fits significantly better than the restricted model respectively for each CRA. This is interpreted that adding the five principal components as predictor variables together (not just individually) results in a statistically significant improvement in model fit, thus all governance variables used for the five principal components in our above analysis affect bank ratings and have explanatory power.

3.4.2 Base model for Governance and Bank Ratings

In this subsection we propose a base model to be used commonly for all three CRAs that embodies a selection from the available governance variables in Table 3.7 so as to examine the relationship between bank ratings and bank governance but also to compare the results with the previous results of the PCA. We decide this base model after attempting many different specifications in combining the available governance variables. We choose governance variables that represent different aspects of governance, and all correspond to the fourth component of corporate governance as explained in section 3.3.2. We choose #BRD_IndNEDs for the structure of the board of directors, AvgTimeEDs for the experience in the executive directors' current roles, #IndNEDsPastCFO/FD for the specialized experience necessary for the independent directors, %GendNEDs and AvgAgeNEDs for the gender and age characteristics of independent directors, and AvgEduNEDs for the education level of independent directors. %IndNEDsAudit and %IndNEDsNomin refer to the structure of committees, and together with CRO represent the contribution of governance to the bank's risk management function. So, we estimate the model of equations (1) and (2) and results are presented in Table 3.11.

Table 3.11: Estimation results for Governance and Bank Ratings

Estimation results for the ordered logit model of the full samples. The dependent variable is equivalently Fitch, Moody's and S&P long-term issuer ratings as defined in subsection 3.3.1 together with the financial explanatory variables, and the governance variables are defined in subsection 3.3.2. Standard errors are calculated using cluster-correlated robust estimate of variance at the bank level, and the asterisks *, **, and *** next to the coefficients values respectively correspond to significance levels 10%, 5% and 1%.

Variables	**Fitch**		**Moody's**		**S&P**	
Financial Variables	Coeff	Z-stat	Coeff	Z-stat	Coeff	Z-stat
LN of Total Assets	2.83***	11.50	2.00***	8.59	2.45***	8.87
ROAA	0.37***	3.69	0.27***	3.60	0.55***	4.17
Total Assets/Equity	-0.001	-0.78	0.02	1.47	0.03***	2.59
Net Loans/Total Assets	-0.003	-0.25	0.01	0.66	0.003	0.25
ST Funding/Total Assets	-0.004***	-2.82	-0.0001***	-3.87	-0.004**	-2.48
Country Rating	0.65***	13.42	0.65***	13.32	0.70***	12.35
Governance Variables						
#BRD_IndNEDs	0.06**	2.06	0.05***	2.01	0.06***	2.19
AvgTimeEDs	0.05*	1.82	0.08***	3.00	0.03***	1.09
#IndNEDsPastCFO/FD	-0.28***	-2.19	-0.26**	-2.46	-0.23**	-2.18
%GendNEDs	0.02***	2.10	0.004	0.46	0.01	1.48
AvgAgeNEDs	-0.05***	-2.15	-0.04	-1.55	-0.03	-0.83
AvgEduNEDs	0.30*	1.82	0.35**	2.41	0.33*	1.74
%IndNEDsAudit	-0.72***	-2.71	-0.48*	-1.85	-1.54***	-4.58
%IndNEDsNomin	-1.06***	-3.37	-0.91***	-3.29	-0.93***	-2.58
CRO	-1.11**	-2.41	-1.80***	-4.23	-0.49	-0.94
Number of Obs	1,735		1,268		1,523	
Pseudo R^2	0.2753		0.2355		0.2658	
Cluster of Banks	191		167		167	

The results for all the financial explanatory variables are similar to the results in Table 3.9, i.e. almost all financial explanatory variables are uniformly statistically significant and have the same expected signs across CRAs. With respect to corporate governance variables, now the results in Table 3.11 are more

interpretable since we can now infer from their coefficient signs. A note should be made that coefficient estimates for all explanatory variables are uninformative with respect to the magnitude each variable affects bank ratings because coefficient estimates are in units of the latent variable $Z_{i,t}$. #BRD_IndNEDs is positive and statistically significant for all three CRAs, which can be interpreted that the higher the number of independent directors in a bank's board of directors affects positively its governance and thus can contribute to a higher credit rating for all three CRAs. Similarly, coefficient estimates of AvgTimeEDs, #IndNEDsPastCFO/FD and AvgEduNEDs, which are statistically significant for all three CRAs, can be respectively interpreted according to their signs that the more time executive directors have been in the current role the better, the less independent directors with past CFO/FD role participate to the board the better and the more qualification independent directors have the better. So, the coefficient estimates for the four aforementioned variables indicate that board structure, expertise of EDs, professional experience and education of independent directors all matter for bank governance and bank ratings for all three principle CRAs. Coefficient estimates of %GendNEDs and AvgAgeNEDs have respectively positive and negative signs for all three CRAs but are statistically significant only for Fitch. This can be interpreted that the gender and the age of the independent directors respectively affect positively and negatively bank governance and thus bank ratings for Fitch. The last three coefficient estimates which we have identified to represent the contribution of governance to the bank's risk management function, i.e. %IndNEDsAudit, %IndNEDsNomin and CRO are all statistically significant for all three CRAs and also they all have negative signs across all three CRAs. On the one hand statistically significant coefficient estimates for all three CRAs show that a bank's risk management function is taken into account within the governance evaluation and thus for bank ratings, but on the other hand the negative signs bring an unexpected result. We would expect a positive sign for all three coefficient estimates, since the participation of a bank's chief financial officer (CRO) to the bank's board of directors can only be perceived positively as it gives the CRO more power and allows him to influence more the decisions of the board of directors. Similarly, the higher the participation of independent non-executive directors in the Audit and Nomination Committees can only be perceived positively, in the same way that #BRD_IndNEDs has a positive sign for all three CRAs.

With respect to the overall predictive power of the model of Table 3.11, similarly to the previous subsection we perform an LR test to assess the difference in fit and results are presented in Table 3.12.

Table 3.12: LR test for the base governance model against the restricted model

	Fitch	Moody's	S&P
LR χ^2	271.74	163.77	263.36
Prob > χ^2	0.0000	0.0000	0.0000

Again, the results in Table 3.12 indicate that for all three CRAs the full model of Table 3.11 fits significantly better than the restricted model respectively for each CRA. This is interpreted that adding the nine selected governance variables together (not just individually) results in a statistically significant improvement in model fit, thus those governance variables affect bank ratings and contribute explanatory power.

3.4.3 Country Institutional Characteristics and Bank Ratings

In this subsection we examine how a country's institutional set-up can affect a bank' s credit rating. When we refer to a country's institutional set-up it should not be confused with either the external support element or the macro-prudential indicators for the bank's country. The external support element is mainly how CRAs assess the potential Government or Institutional Support for a bank, while macro-prudential indicators are systemic risk measures that CRAs use in the process of sovereign ratings. In a similar study by Caporale, Matousek and Stewart (2012) where an international sample of bank ratings is analysed, the authors develop a country index to reflect cross-country differences and their effect on ratings. We choose to use in our model the seven country institutional components presented in subsection 3.3.3 in order to examine how each country's institutional characteristics affect bank credit ratings.

Again, we estimate the model of equations (1) and (2), where matrix Y_{it} instead contains the seven country institutional components. Results are presented in Table 3.13 and we observe that the coefficient estimates of all seven country institutional components are statistically significant across the three

Table 3.13: Estimation results for Country Institutional Characteristics

Estimation results for the ordered logit model of the full samples. The dependent variable is equivalently Fitch, Moody's and S&P long-term issuer ratings as defined in subsection 3.3.1 together with the financial explanatory variables, and the country institutional characteristics defined in subsection 3.3.3. Standard errors are calculated using cluster-correlated robust estimate of variance at the bank level, and the asterisks *, **, and *** next to the coefficients values respectively correspond to significance levels 10%, 5% and 1%.

Variables	**Fitch**		**Moody's**		**S&P**	
Financial Variables	Coeff	Z-stat	Coeff	Z-stat	Coeff	Z-stat
LN of Total Assets	2.71***	13.56	2.05***	10.85	2.03***	6.49
ROAA	0.25***	4.27	0.29***	4.05	0.4026***	4.22
Total Assets/Equity	-0.0001***	-12.45	0.0014	0.17	-0.0001***	-11.51
Net Loans/Total Assets	-0.01	-0.70	0.01	0.62	-0.02	-1.39
ST Funding/Total Assets	0.00***	-2.84	-0.0001***	-5.67	-0.01**	-2.11
Country Rating	0.29***	4.67	0.29***	4.19	0.45***	6.15
Country Institutional Characteristics						
Law and Order	0.21	1.20	0.04	0.19	0.41**	2.39
Investment Profile	0.47***	5.62	0.42***	4.07	0.34***	3.93
Socioeconomic Conditions	0.25***	3.69	0.36***	4.41	0.14	1.33
Government Stability	0.16***	3.07	0.08	1.50	-0.03	-0.47
Corruption	0.24*	1.68	0.43***	2.62	0.09	0.59
Democratic Accountability	0.47***	3.31	0.16	0.87	0.33**	1.98
Bureaucracy Quality	-1.05***	-3.83	-0.66**	-2.04	-1.25***	-4.11
Number of Obs	2,207		1,550		1,876	
Pseudo R^2	0.2706		0.2287		0.2280	
Cluster of Banks	197		174		169	

CRAs. Coefficients of Investment Profile and Bureaucracy Quality are statistically significant across all three

CRAs, while the rest of the coefficients are statistically significant for either two or one of the CRAs. Thus, the use of those indicators adds to the explanatory power of the model. With respect to the signs observed, the expected signs for all coefficients are positive since all components give the maximum value when a

country best performs for a particular category. So, all coefficients have the expected positive sign, except for the coefficient of the corruption components that is negative for all CRAs.

Lastly, once again we perform an LR test to assess the difference in fit and results of the LR test are presented in Table 3.14.

Table 3.14: LR test for the Country Institutional Characteristics against the restricted model

	Fitch	Moody's	S&P
LR χ^2	315.56	159.37	182.00
Prob > χ^2	0.0000	0.0000	0.0000

Again, the results in Table 3.14 indicate that for all three CRAs the full model of Table 3.13 fits significantly better than the restricted model respectively for each CRA. So, by adding the seven country institutional components together (not just individually) results in a statistically significant improvement in model fit, thus those country institutional components variables affect bank ratings and contribute to the explanatory power.

3.4.4 Structural Break in Bank Governance

In this subsection we aim to examine whether the relationship of bank governance and bank credit ratings changed in the periods before and after the global financial crisis, i.e. for the periods until 2008 and from 2009. In order to do so, we again estimate the model of equations (1) and (2) again for the base model proposed of the nine governance variables defined in sub-section 3.4.2, but for two subsamples, i.e. for the periods until 2008 and from 2009. Our analysis for structural breaks in Table 3.15 is focused only for the nine governance variables, so results for the remaining coefficients are disregarded. For Fitch, all the null hypotheses that the coefficient estimates for each of the nine governance variables are equal in the periods until 2008 and from 2009 are not rejected, which is an indication that the relationship between governance and bank ratings did not change, i.e. there is no indication of structural breaks in governance for Fitch. For Moody's, two of the null hypotheses are rejected, i.e. for the coefficient estimates of #IndNEDsPastCFO/FD and %GendNEDs, but still this is not enough to conclude that the relationship between governance and bank ratings changed, i.e.

Table 3.15: Estimation results for Structural Breaks in Governance Variables

Estimation results for the ordered logit model of equations (1) and (2) for the periods until 2008 and from 2009. The dependent variable is equivalently Fitch, Moody's and S&P long-term issuer ratings as defined in subsection 3.3.1 together with the financial explanatory variables, and the governance variables are defined in subsection 3.3.2. Standard errors are calculated using cluster-correlated robust estimate of variance at the bank level, and in each row we observe the values of $\chi 2$ and p-value for Wald $\chi 2$ test for the Hypothesis that the respective governance variables' coefficient estimates for each CRA are equal in the periods until 2008 and from 2009. The asterisks * next to the p-values correspond to significance levels 5% and denote that can reject the null hypothesis

Variables	**Fitch**		**Moody's**		**S&P**	
	χ^2	*p-value*	χ^2	*p-value*	χ^2	*p-value*
Governance Variables						
#BRD_IndNEDs	0.14	0.7097	1.42	0.2336	0.06	0.8138
AvgTimeEDs	3.78	0.0519	1.89	0.1693	4.06	0.0439*
#IndNEDsPastCFO/FD	0.00	0.9689	5.13	0.0236*	2.98	0.0842
%GendNEDs	0.34	0.5601	4.61	0.0319*	0.04	0.8403
AvgAgeNEDs	0.18	0.6671	1.87	0.1718	0.55	0.4568
AvgEduNEDs	0.05	0.8293	0.55	0.4601	0.30	0.5832
%IndNEDsAudit	0.03	0.8557	0.03	0.8697	0.03	0.8641
%IndNEDsNomin	2.41	0.1207	0.13	0.7139	0.79	0.3743
CRO	0.94	0.3313	0.02	0.8873	0.03	0.8699

there is no strong indication of structural breaks in governance for Moody's. Lastly, for S&P, only one of the null hypotheses is rejected, i.e. for the coefficient estimate of AvgTimeEDs, and again this is not enough to conclude that the relationship between governance and bank ratings changed, i.e. there is no strong indication of structural breaks in governance for S&P.

3.5 Conclusion

Weak corporate governance has been blamed in the past as a key factor in different occasions of financial turmoil during the past two decades. The two most prominent cases were the high-profile corporate collapses in 2001-2, where accounting fraud was attributed to weak governance, and in 2007-8, when the failure of large financial institutions was partly attributed to the failure of corporate governance and risk management of financial institutions.

This essay uses a mechanism to model governance in bank credit ratings by the three principal CRAs for a worldwide sample from 1999 to 2014. We use a simple model of prediction of bank ratings that controls for bank financial characteristics and sovereign ratings that prior literature has shown to be related to bank credit ratings. Due to the large number of available governance variables, we initially perform PCA analysis for the governance variables and using the component scores in our model of prediction of bank ratings we conclude that all governance together have a statistically significant improvement in model fit, and thus have explanatory power for bank ratings.

Next, we decide a base model specification choosing a number of the available governance variables to examine different aspects of governance. Bank ratings improve from the number of independent directors in a bank's board of directors, from the time directors have served in the current role, from the less independent directors with past CFO/FD role participate to the bank's board, from the more qualifications of independent directors, and from male and younger independent directors. Results for risk management related governance variables result in an unexpected negative sign.

Besides governance we examine if a country's institutional set-up can affect a bank' s corporate governance and thus its credit rating and find that for the seven country institutional components are statistically significant across the three CRAs. The components used are Government Stability, Socioeconomic Conditions, Investment Profile, Corruption, Law and Order, Democratic Accountability and Bureaucracy Quality.

Lastly, we find that the relationship of bank governance and bank credit ratings did not change in the periods before and after the global financial crisis, i.e. for the periods until 2008 and from 2009. For the governance variables used in our base model, we find that there is no indication of structural breaks in governance for Fitch, while for Moody;s and S&P there is no strong indication.

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Structural Shifts in Bank Credit Ratings

ABSTRACT

It is an often noted fact that the quality of credit ratings is questioned after different occasions of financial turmoil. In the event of the most recent global financial crisis of 2007-8, the popular claim is that the Credit Rating Agencies (CRAs) loosened their rating standards before the crisis, and in the aftermath of the crisis revised their rating methodologies to tighten rating standards. Even though empirical literature on the evolution and the determinants of credit ratings is extensive regarding corporate (non-financial) ratings, similar investigations on bank credit ratings banks is scant, which is surprizing especially in the light of the 2007-8 financial crisis. In this essay, I contribute to the empirical literature by investigating the time variation in credit rating standards for financial institutions by the three principal CRAs from 1990 to 2015 for in a world-wide context. We distinguish three structural breaks in the bank rating standards dividing the time-span of our analysis to the period before and after the 2001-2 high profile corporate collapses when credit rating standards tightened, the period before the global financial crisis started when bank credit rating standards loosened, and the period after the global financial crisis when bank credit rating standards tightened. Overall we can say that for the period of our study, Moody's and Standard & Poor's were rather more aligned in their structural shifts of bank credit rating standards, and all three principal CRAs were unanimous in the hardening of bank credit rating standards for US and Canadian banks in the post global financial crisis period. Fitch, as the last entrant to the credit rating industry, seems to have followed a more conservative policy before the global financial crisis compared to the other two agencies which dominated the market of credit ratings. Lastly, Fitch gives higher credit ratings for US, Canadian and Rest of the World banks in the presence of competition.

1. Introduction

1.1. Background

Besides the governance issues that the three principal Credit Rating Agencies (CRAs) faced in the aftermath of the 2001-2 high profile corporate collapses, in the wake of the global financial crisis of 2007-8 the ability of the three principal CRAs (i.e. Standard and Poor's, Moody's and Fitch) to assess risk once again came under increased scrutiny, this time for their rating methodologies with respect to financial institutions. It is indicative to say that many banks that failed during the crisis enjoyed investment grade ratings just before defaulting, while similar situations existed for ratings of bank products. Many large institutions around the world were threatened with collapse, and national governments were forced to facilitate massive bailout programs to prevent serious financial and subsequent economic downturns. The overall impression has been that the entire rating system was flawed, and in line with this, the Financial Crisis Inquiry Commission (F.C.I.C.) in the U.S, in its report that was published in January 2011 mentioned that "the three credit rating agencies were key enablers of the financial meltdown".

In response, all three principal CRAs immediately proceeded to major downgrades in the banking sector and, right after the global financial crisis of 2007-8, and started revising their rating methodologies and assessments (e.g. Fitch Ratings, 2011a, 2011b; Moody's, 2009), which resulted to further downgrades in the banking sector. The three principal CRAs made efforts to increase transparency in the process of assessing banks' creditworthiness, while enhancing the role of official support. So, the overall picture changed and rating agencies became more stringent while at the same time in greater agreement about bank ratings methodologies.

Despite the significance of credit ratings for the financial system, their determinants are poorly understood even though empirical literature on this field is abundant. In parallel to this, despite the significance of the financial sector in the economy as a whole, empirical literature specifically on bank credit ratings and the quality of such ratings is scant. This last fact is surprising given the aforementioned discussion about the role of banks and CRAs in the global financial crisis of 2007-8. Moreover, credit ratings are expected to be truly informative on banks' riskiness throughout the cycle that is not otherwise available

to the market, so it's an additional reason that empirical literature would have been expected to be rich on the analysis and comparisons of bank credit ratings.

1.2. Motivation

The global financial crisis of 2007-8 has triggered an increase in theoretical literature of agency and incentive problems relating to bank credit ratings (Mathis, McAndrews, and Rochet, 2009; Bolton, Freixas, and Shapiro, 2012; Opp, Opp, and Harris 2013). Some of the most well discussed topics of agency problems on credit ratings are the conflict of interest between the rating consumer (financial investor) and the issuer; the rating-contingent financial regulation of banks and other investors, the agency problems related to the reputational capital of CRAs and the competition among rating agencies.

Literature on the information content of corporate credit ratings has always been of great interest due to their importance in their financial system. Blume, Lim, and Mackinlay (1998) were the first to document the phenomenon of stringency (or hardening or conservatism) in assigning ratings. In the aftermath of the global financial crisis, the interest in the literature for the time variation of corporate rating standards was augmented and two prominent studies first by Alp (2013) and subsequently by Baghai, Servaes, and Tamayo (2014). Both studies found no evidence that rating agencies reduced their rating standards. But as already mentioned empirical literature on bank ratings was and remained scant despite the potential interest due to their connection with global financial crisis of 2007-8. Namely, it is apparent that the quality of bank credit ratings was crucial for the development of the global financial crisis of 2007-8, but also for the turmoil in the financial sector in the following years. So, the empirical analysis of the quality of bank rating standards before, during and after the global financial crisis of 2007-8 can give valuable answers to the causes of the crisis.

This paper is related to two strands of the literature on credit ratings. The first strand is examining the quality (what do you mean by quality/ determinants) of credit ratings, while the second is focused the information content of bank credit ratings. So, the first strand solely involves studies for non-financial firms, while the second strand involve few studies for the information content of bank ratings.

It should be highlighted that factors that determine the ratings and the creditworthiness of the banks are particularly important for a number of reasons, with the most important being the central role banks have in the economy. The

well-being of the banking system is vital for economic development and growth, while better understanding of bank ratings can alleviate information asymmetries.

1.3. Aim and Research Questions

1.3.1. Aim

Prior literature on credit rating standards have been adequate while mainly focusing on corporate credit ratings (Lucas and Lonski, 1992, Blume, Lim, and Mackinlay, 1998, Cheng and Neamtiu, 2009, Becker and Milbourn, 2011, Alp, 2013). At the same time, literature on modelling and prediction of banking ratings is sparse. The aim of this study is to identify time-series variation in bank credit rating standards from 1990 to 2015 by the three principal CRAs, i.e. Moody's, Fitch and S&Ps. Within the context discussed above, this essay aims to close the gap in the literature regarding the lack of research on bank credit ratings standards. So, the intention here is to enhance knowledge on the shortfalls that global financial crisis of 2007-8 exposed in bank rating standards, while at the same time giving useful insights on how the three principal CRAs have tightened or loosened their standard within the period under investigation.

So, given the publicly available information set to three principal CRAs since the beginning of the period under investigation, we aim to examine the time variation of bank rating standards and explore possible structural shifts for all three principal CRAs.

1.3.2. Research Questions

The research topics of interest that are identified and remain under-explored are: the changes in bank rating standards and the possible existence of structural shifts in bank rating standards. More specifically, this paper aims to shed light on the following questions:

i. Using an international sample of banks, have there been changes in bank rating standards of each of the three principal CRAs from 1990 to 2015?

ii. Have there been structural shifts in bank rating standards of each of the three principal CRAs that divide the period under investigation into subperiods?

iii. Are changes in bank rating standards different for each or for one of the three principal CRAs and are there different structural shifts for the period under investigation?

iv. Does the presence of competition affect the rating decisions of each of the three principal CRAs?

Before proceeding with the investigation of the empirical evidence, we first proceed with a review of the related literature on credit ratings and then with a review of the bank rating methodologies of the three principal CRAs.

2. Literature Review

2.1. Theoretical Literature

Theoretical literature for the role of rating agencies is related to the literature on information intermediaries. In this literature, information intermediaries are generally involved in obtaining and verifying information by committing to disclosure rules (Lizzeri, 1999). Credit rating agencies do not commit to disclosure rules but are motivated by the reputation costs when they provide inaccurate information.

An early paper in this field is by Kuhner (2001), which uses a static model to determine the conditions under which rating agencies have incentives to misreport ratings during a period of crisis. Similarly, most of the early literature considers non-strategic rating agencies, i.e. agencies that do not strategically build on their reputation to later inflate their reported ratings in order to gain more business by their clientele. In line with this static modelling and not strategic rating agencies literature there are studies such this by Boot, Milbourn and Schmeits (2006) that examines the role of CRAs in financial markets, Farhi, Lerner and Tirole (2008) that focuses on other aspects of ratings such as their transparency and coarseness, and also by Skreta and Veldkamp (2009). The latter study investigates the problematic ratings of structured credit products, which were one of the main contributors to the global financial crisis of 2007-8. The authors model the characteristics of rating shopping and rated assets complexity to find that a systematic bias could be created in disclosed ratings when assets are sufficiently complex. When competition increases among agencies the problem worsens and switching to an investor-initiated ratings system reduces the bias but could collapse the market for information.

Theoretical literature on rating agencies increased when the global financial crisis of 2007-8 started, as the role of rating agencies was under scrutiny, not only by regulator but also by academia. Two of the most cited papers are the one by Mathis, McAndrews, and Rochet (2009) who tackle the issue of reputation building by a strategic CRA in a dynamic model, and the other by Bolton, Freixas, and Shapiro (2012) who examine further the effects of competition among rating agencies. Mathis, McAndrews, and Rochet (2009) examine how a CRA's concern for its reputation affects its ratings quality. They present a dynamic model of reputation in which a monopolist CRA may mix between lying and truth-telling to build up or exploit its reputation. The authors focus on whether an equilibrium in

which the CRA tells the truth in every period exists, and they demonstrate that truth-telling incentives are weaker when the CRA has more business from rating complex products. Empirical support is presented, showing that the percentage of AAA rated residential mortgage-backed securities (RMBS) increased from 2001 to 2007. Bolton, Freixas and Shapiro (2012) also use a dynamic model of strategic CRAs to examine the outcome of equilibrium in a competition setting among CRAs. CRAs face more conflicts of interest when reputation costs are lower, and investors are more trustworthy. As a result, the authors find that competition among CRAs reduces reporting efficiency (here say something about the use of information) because of rating shopping and that ratings can be inflated in good times of economic expansion. Bar-Isaac and Shapiro (2011) examine incentive framework for rating analysts at CRAs and find that CRA accuracy is non-monotonic and countercyclical. Ratings accuracy increases at first because of more effort from the analysts, but then it may decrease because of the lower CRA training incentives due to the probability that analysts may have outside offers from banks.

Other studies in line with the above are by Faure-Grimaud, Peyrache, and Quesada (2009), who also find that that competition between rating agencies may result in less information disclosure, and by Opp, Opp, and Harris (2013), The authors of the latter study show that ratings inflation in structured products can be explained by the differences in the regulatory reliance on ratings across various instruments and also the differences in the complexity of instruments, whereas this does not hold for corporate ratings. Bar-Isaac and Shapiro (2013) also use a dynamic model of endogenous reputation formation and changing economic environment to find that ratings quality is procyclical. Additional factors that reduce ratings quality are increased fee-income, high competition for analysts in the labour market, and naive investors. According to the authors, the same results hold under a competitive environment. These findings for the procyclical character of ratings by Bar-Isaac and Shapiro (2013) are interesting for the scope of our study, since while examining structural shifts the procyclical or countercyclical nature in ratings quality is important.

2.2. Empirical Literature

The empirical study in this essay is mostly related to the work of Alp (2013) and Hau, Langfield and Marques-Ibanez (2012). The study of Alp (2013) belongs

to a strand of studies that examine the characteristics of credit ratings, including their informativeness, perceived bias, and changes over time, while the study of Hau, Langfield and Marques-Ibanez (2012) belongs to a strand of studies that specifically examine the information content of bank ratings.

2.2.1. Literature on the characteristics of credit ratings

The paper by Alp (2013) is a study on S&P Long-Term Issuer ratings of US non-financial firms testing the time-series variation of rating standards. The main findings are that from 2002 to 2007 a structural shift occurs towards stringency, and that from 1985 to 2002 a "divergent pattern" exists between investment-grade and speculative-grade rating standards, i.e. investment-grade standards tighten, and speculative-grade standards loosen. The work of Alp (2013) is closely related to the paper of Blume, Lim, and Mackinlay (1998). Blume, Lim, and Mackinlay (1998) also study investment-grade rating standards of US corporations between 1978 and 1995 using the S&P bond-level ratings. They show that the evident deterioration in the credit quality of U.S. firms seems to be driven at least in part by the stricter standards employed by the rating agencies.

These two studies, even though they concentrate on changes of rating standards over time, they are indicative of the first strand of studies mentioned above that examine how publicly available information predict credit ratings. The studies in this strand are for non-financial firms mainly in the US.

These are preceded by studies within this context such as those of Horrigan (1966), Pogue and Soldofsky (1969), and West (1970) and later studies, those of Pinches and Mingo (1973, 1975) and Altman and Katz (1976) and Kaplan and Urwitz (1979). The latter study is probably the first to use an ordered probit model to examine whether publicly available data predict bond ratings in the US, while it summarized and criticised previous studies.

More recent studies include those of Ederington (1985), that compares the statistical approaches of earlier studies, and Jackson and Boyd (1988) that uses a probit model to identify which variables are important in affecting raters' perceptions of bond quality rather than which variables increase the percentage of correctly classified ratings. Lucas and Lonski (1992) describe changes across the full spectrum of Moody's ratings. They document that long-term downgrades versus upgrades deteriorated (explain) from a 1.17 average in the 1970s to 2.17 in the 1980s, and to 4.93 in 1990. They also document that while this declining

trend existed in ratings, at the same time ratings activity increased. Carty and Fons (1993) record similar findings, i.e. a deterioration in the credit quality and increase in rating activity since the end of the 1970s. Cantor and Packer (1995) is a study for the whole credit rating industry and one of the first studies also concentrate on bank ratings. The authors examine the correspondence of ratings with default rates and find differences among principal agencies in their ratings for junk bonds, international banks, and mortgage-backed securities. The same authors, Cantor and Packer (1997) examine rating split with respect to different rating scales and selection bias and find only limited evidence of the later.

In a different context, Altman and Saunders (1998) analyses the techniques traditionally used in the literature for identification of the determinants and prediction of ratings, which are identified by multivariate discriminant analysis, the logit model and the probit model. Kisgen (2006) examines the extent that a firm's credit rating fluctuations affect its capital structure decisions, while Beaver, Shakespeare and Soliman (2006) is a study that examines the differences in published ratings of certified versus non-certified bond-rating agencies in the US, and finds that certified agencies are more conservative and consistent. Amato and Furfine (2004), using a sample of US firm ratings by S&P, examine the effect of the business cycle on credit ratings and find that CRAs do not assign ratings that are excessively procyclical. However in contrast to Amato and Furfine (2004), Auh (2013) finds that rating standards are in fact procyclical, i.e. ratings during an economic downturn are stricter compared to ratings during an expansion, whilst deHaan (2017) finds no deterioration in the performance of corporate credit ratings during or after the crisis. deHaan (2017) concludes that corporate credit rating performance improves after the crisis, which is attributed to the response of CRAs to investor criticism and regulators.

Other studies addressing the information context of credit ratings relate to credit ratings' lack of timeliness. It is indicative to mention the renowned bankruptcies such as that of Enron, which maintained investment-grade rating days before its declared bankruptcy. Cheng and Neamtiu (2009) examine the quality of ratings with respect timeliness, accuracy and stability before and after the Sarbanes-Oxley Act (SOX), which is considered to have increased the regulatory pressure and criticism to CRAs due to the high profile corporate collapses like that of Enron. The authors define two periods, the period before SOX (1 January 1996 - 25 July 2002) as the pre-criticism period and the period after SOX (25 July 2002 - 31 Dec 2005) as the criticism period, using credit ratings

by the three principal CRAs. They find that on average ratings of defaulted companies in the one-year period leading to default are lower in the criticism period compared to pre-criticism period. They conclude that CRAs improved both in timeliness and accuracy of their ratings after SOX, also reducing ratings volatility. Dimitrov, Palia and Tang (2015) examine the impact of the Dodd-Frank act (which took place in July 21, 2010) on corporate bond ratings by all three principal CRAs in the US. The authors find that because of the act, CRAs assign lower ratings, and thus give more false warnings, and issue downgrades that are less informative. The effect of increased competition by the presence of Fitch, lessens the effect of lower ratings, while results are not procyclical.

Baghai, Servaes, and Tamayo (2014) is a study very close to that of Alp (2013), since both belong to the growing sub-strand of literature that focuses on the time-series variation in rating standards. Baghai, Servaes, and Tamayo (2014) use a sample of US firms ratings by S&P, from 1985 to 2009, and find that CRAs have become more stringent or conservative during this period, with average ratings dropping by three notches. According to the authors, this finding is not consistent with the observed decrease in the default rates during this period. Jiang, Stanford, and Xie (2012), that find that S&P assigned higher ratings in 1974 after it changed its pay model from the investor-pay to the issuer-pay. Another interesting finding is reported by Becker and Milbourn (2011). The authors examine how the entry of Fitch, as a third material entry in the credit rating industry, affected competition and ultimately the quality of ratings. Their key finding is that when Fitch increases its market share in certain industries, rating standards become slightly relaxed.

Contrary to the vast majority of studies that converge to the stringency or conservatism of rating standards, Jorion, Shi, and Zhang (2009) argue that the apparent tightening of rating standards can be attributed primarily to improvement in accounting quality over time. The authors use a sample of U.S. firms from 1985 to 2002 for S&P long-term issuer credit rating and come to this conclusion only for investment-grade issuers.

2.2.2. Literature on bank ratings

What characterises the literature on modelling and prediction of bank ratings is its sparsity (Salvador, Pastor and Fernandez de Guevara, 2014), as few studies focus exclusively on bank ratings.

The second study mentioned above of Hau, Langfield and Marques-Ibanez (2012) belongs to this strand of studies that examine bank ratings, and it is one of the most comprehensive analysis of bank credit ratings. The authors examine the information content of bank credit ratings, based on approximately 39,000 quarterly bank ratings over the period 1990–2011 from the three principal CRAs and for banks in Europe and the US. The authors use a new method for evaluating rating quality, that employs two ranks and transforms bank credit ratings in a strictly ordinal manner. They find that ordinal rating quality is countercyclical, i.e. the information content of credit ratings is higher during banking crises, and that bank ratings in the upper investment grade range do not correspond to their expected default probabilities, i.e. are less risky. Also, other findings are that large banks enjoy systematically better credit ratings relative to their expected default risk, and banks that provide large securitization business to a CRA are expected to receive a more favourable rating from this CRA.

One of the earliest studies on bank ratings is that of Cantor and Packer (1995) also mentioned above. This study finds evidence that uncertainties about banks' creditworthiness lead agencies to disagree more about bank ratings than about the ratings of firms in other industries, which is also found in a later study by Morgan (2002). Morgan (2002) finds similar results comparing ratings from Moody's and S&P. He uses ordered logit regressions in an attempt to identify the determinants of the difference in bank rating assignments. His work is motivated by the inherently opaque nature of banks to outside agents, including CRAs, who assess the risks taken by banks. Cantor et al. (2001) is also a study that concentrates on banks and non-banks. Comparing ratings among US and non-US firms, the authors find that US firms had higher annual default rates both for banks and non-banks.

Other studies in this strand are Peresetsky and Karminsky (2008), who find that Moody's ratings also take into account external factors such as political risk, while Bellotti et al. (2010), who focuses on the prediction techniques of bank ratings using both ordered logit modelling and Support Vector Machine (SVM) techniques. Caporale, Matousek and Stewart (2011) through the use of probit and logit models find that significant differences exist among Fitch bank ratings of different countries in the European Union, i.e. bank country is a crucial factor of ratings. Similarly, Caporale, Matousek and Stewart (2012) again using country indices but this time in an international sample of 90 countries emphasize both the significance of fundamental quantitative financial analyses and the country effect.

In addition the authors find that during periods of financial instability both CRAs and quantitative models are likely to produce highly inaccurate predictions of ratings. The two aforementioned studies are close to the results obtained by Peresetsky and Karminsky (2008) since they all show the influence on bank ratings of external factors, such as the legal framework, government support, ownership, etc. In a similar context but in the same strand of literature on bank ratings, Iannotta, Nocera and Sironi (2013) examine the influence of government ownership of European Union Banks on all three principal CRAs ratings. Using an ordered logit model, the authors find evidence that banks that are publicly owned receive higher ratings than banks that are privately owned.

Packer and Tarashev (2011) observe the behaviour of all three principal CRAs' bank ratings and provide evidence that after the outbreak of the subprime crisis bank ratings fall and the differences between different agencies' bank ratings decrease. The authors also highlight the importance of the external support banks received from national authorities. Van Laere, Vantieghem and Baesens (2012) find that S&P sets more strict rating standards for banks than Moody's, while Moody's is more sensitive to the economic climate. They also find that although the CRAs rating standards changed (in response to the financial crisis) they have not become aligned, and the level of discretion in the rating process increases with bank opacity. In another study, Shen, Huang and Hasan (2012) examine why bank credit ratings are different for banks with constant financial ratios but in different countries. The authors model the issuer ratings of Standard and Poor's to determine the reasons behind the variation of ratings and they conclude that asymmetric information differences among banking systems are the key factor explaining the differences in ratings. Similarly, Huang and Shen (2015) examine the effect of sovereign credit ratings on bank credit ratings and conclude that the sovereign rating is an important determinant that affects the bank ratings but in a different fashion for S&P and Fitch.

Finally, two of the most current studies in the field of bank credit ratings are by Salvador, Pastor and Fernandez de Guevara (2014) and Salvador, Fernández de Guevara and Pastor (2018). Salvador, Pastor and Fernandez de Guevara (2014) is a study for the Spanish banking sector for ratings by the three principal CRAs during 2000-2009. The main finding is that ratings are pro-cyclical as the worsening of bank credit ratings that followed the global financial crisis of 2007-8 is partly attributed to the hardening of rating standards. Salvador, Fernández de Guevara and Pastor (2018) using a sample of bank from Europe,

US and Japan during the period of 2004 to 2013, find that the hardening of rating policies as a result of the global financial crisis, was more in an descending order by Fitch, S&P and then Moody's. In another study, King, Ongena and Tarasev (2017) examine and conclude that the decision of Fitch rating to release standalone ratings for rated banks did not affect bank all-in ratings. The change in Fitch's rating methodology had more positive than negative ratings surprises of standalone rating refinements.

3. Bank Rating Methodologies by the three big CRAs

3.1. Introduction

A broad definition for credit ratings is that they are an opinion for the creditworthiness of entities, may it be a sovereign, an institution or a financial instrument. Fitch's credit rating description for entities is that it is an opinion on the relative ability to meet financial commitments, such as interest, preferred dividends, repayment of principal, insurance claims or counterparty obligations. Moreover, credit ratings should not vary in a procyclical manner, as they are expected to distinguish the relatively risky entities from the relatively safe entities (Amato and Furfine, 2004). In this way, credit ratings are expected to be ordinal rankings of risk across entities at a particular point in time, rather than absolute measures of default probability that are constant through time (Cantor and Mann, 2003).

Rating agencies, together with other market participants like credit markets and financial analysts, face increased difficulties in forecasting the performance of banks not only due to the their complexity but also due to the unique role they hold in the economy as financial intermediaries and more notably their importance for financial stability. The latter is the reason for the external assistance they receive which is inevitably taken into account by the rating agencies, besides the bank financial profile.

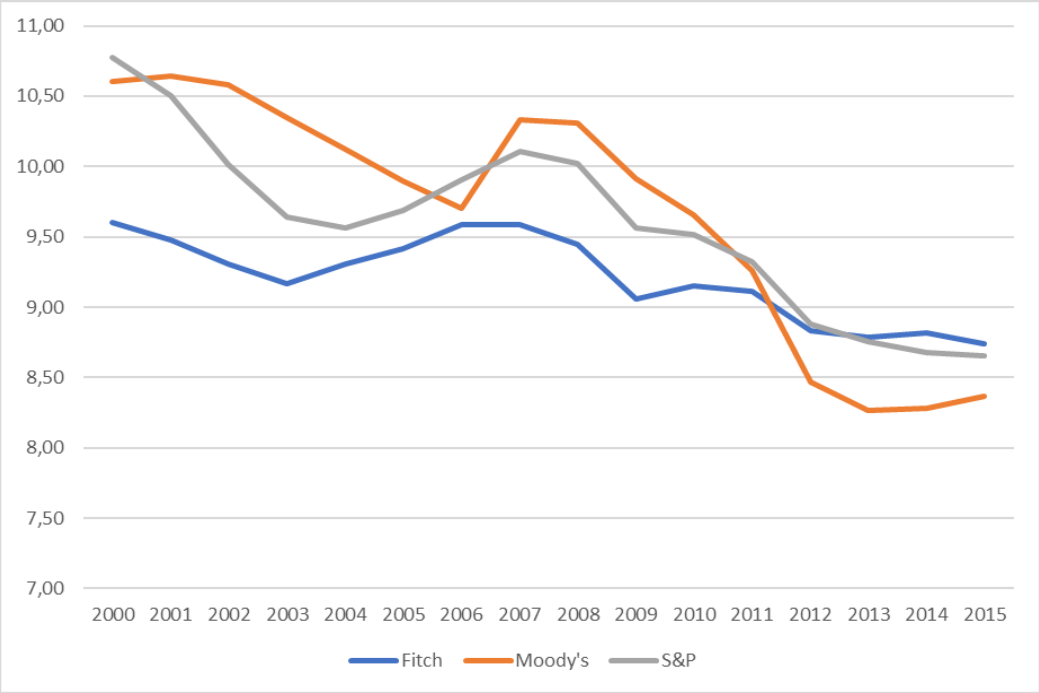
In the following section, we first observe how the average bank ratings of the three principal CRAs have evolved during the period of 2000-2015 in order to have a foretaste before we examine the evolution of bank rating methodologies. While examining the evolution of bank rating methodologies of the three principal agencies, we focus on changes after the global financial crisis. In the last section, we examine the implication of the geographical or country factor in bank credit ratings.

3.2. Global mean evolution of bank credit ratings by the three principal CRAs

Soon after the global financial crisis of 2007-8, all three credit rating agencies started reassessing bank rating methodologies, which resulted in prominent downgrades for bank ratings, especially for European and US institutions (Parker and Tarashev, 2011). For all three CRAs, the most important changes in their bank methodologies took place in 2011, at a point that lessons were learned for the financial industry (Fitch Ratings, 2011a, Moody's, 2009 and Standard & Poor's, 2011a).

In order to have an insight for the evolution of bank rating methodologies, we first observe the evolution of the global mean of bank credit ratings by the three principal CRAs. Credit ratings are transformed from their letter form into a numerical value that corresponds to an ordinal scale ranging from 1 to 17, as explained in the subsequent subsection 4.3.1.1. A close first look at the global mean of bank credit ratings for the three principal CRAs in the Figure 3.1 is revealing.

Figure 3.1 Plot of mean values of bank credit ratings from 2000 to 2015, for the three principal CRAs[4]



[4] Means are calculated for our world sample of bank credit ratings, after transforming credit ratings from their letter form into a numerical value that corresponds to an ordinal scale ranging from 1 to 17. Value of 1 corresponds to the lowest rated banks (CCC+/Caa or worse) and value of 17 to the highest rated banks (AAA/Aaa), according to Table 4.2.

Some first key findings can be inferred from the above figure. First, all three principal CRAs' average bank ratings demonstrate a U-curve from 2000 to 2007. This is translated as a deterioration of average bank credit rating in the first years after 2000, and then an improvement until 2007. Second, after 2007 bank ratings worsened in two stages, during the period 2008-9 and then during the period 2010-12, where a sharper deterioration took place. Third, bank ratings of the three principal CRAs converged and stabilized during the period after 2013.

3.3. Bank rating methodologies of CRAs

All three principal CRAs have developed distinct methodologies for rating financial institutions. Nevertheless, all methodologies have in common two main elements: the intrinsic or stand-alone and the external support element. Assessment methodologies applied to banks do not apply to non-bank financial institutions, for which different methodologies apply. In the following subsections the rating methodologies of each of the three principal CRAs are briefly discussed.

3.2.1. Fitch Ratings bank rating methodology

Fitch Ratings methodology for banks includes specific factors of bank credit risk that are divided into the intrinsic creditworthiness of the bank and the potential of external support (Fitch Ratings, 2018). Intrinsic creditworthiness concerns a stand-alone rating called Viability Rating (VR), while the potential of external support concerns Support Rating (SR) and Support Rating Floor (SRF). The overall or all-in rating is called Issuer Default Rating (IDR) and is derived from the Viability Rating and the External Support Ratings. Long-term IDRs are assigned to all banks, while short-term IDRs are assigned for the likelihood of default in the short term (if the bank has short-term obligations), where "short term" means up to 13 months.

So, Fitch Ratings' current rating framework for banks (Fitch, 2018) is comprised from the following Issuer Ratings:

- Long-Term or Short-Term IDRs
- Viability Ratings
- Support Ratings
- Support Rating Floors
- Derivative Counterparty Ratings

The first four ratings were defined above while Derivative Counterparty Ratings (DCR) are issuer-level ratings and unlike the Long-Term IDRs are only assigned to selected banks. Also, Long-Term IDRs are assigned to all banks with international ratings (i.e. a combination of intrinsic and external support analysis), where Short-Term ratings are assigned to rare cases of banks that issue exclusively short-term debt.

Before further discussing Viability Ratings, which reflect the fundamental creditworthiness of a bank, a few words should be added for the two support ratings that represent the potential of external support. SR reflects the likelihood that a bank will receive extraordinary support in case of need, where the source will be either the bank's shareholders (i.e. institutional support) or the national authorities of the country (i.e. sovereign support). SRF indicates the minimum level to which the entity's Long-Term IDR could fall for the level of extraordinary support assumed, based on sovereign support. In this context, both the ability and propensity of the potential supporter to provide assistance are taken into account.

Fitch Ratings' methodology for banks has evolved in time to become as described above. One of the changes in the methodology took place in 2011 when Viability Rating was introduced (Fitch Ratings, 2011a, 2011b) as the stand-alone rating of bank institutions. Until 2011, Fitch's stand-alone rating was called Individual Rating and had a 10-point rating scale ('A' best to 'F' worse). In early 2011, Fitch first signalled its intention to refine the scale of standalone ratings (Fitch Ratings, 2011a, 2011b), which existed ever since Fitch begun rating banks. Fitch's Individual Rating was withdrawn in early 2012 as more transparency was needed by directly corresponding its all-in rating ("issuer default ratings"). Viability Rating has a 19-point scale that corresponds exactly to that of its all-in ratings, although using the lower case ('aaa', 'aa+' etc). Even though the replacement of Individual Rating by Viability Rating appears as a major change that could affect the all-in rating, as already mentioned according to King, Ongena and Tarasev (2017), the all-in ratings were not affected.

When first presented, Viability Rating's key factors (Fitch Ratings, 2011a, 2011b, 2011c) were as follows: a. Industry profile and operating environment, b. Company profile and risk management, c. Financial profile, and d. Management strategy and corporate governance. The key factors mentioned in Fitch's most recent bank rating criteria (Fitch Ratings, 2018) are: a. Operating Environment, b. Company Profile, c. Management and Strategy, d. Risk Appetite, and e. Financial

Profile. Some changes have taken place in the factors determining Viability Rating, but still do not appear substantial.

In the same manner, changes of the key elements of a bank's financial profile do not seem substantial. In 2011 (Fitch Ratings, 2011a), the key elements for the financial profile assessment were: a. profitability, b. funding, and c. liquidity and capitalization. Asset quality was mentioned as an important rating driver that could be considered part of a bank's financial profile. In the latest bank rating criteria report (Fitch Ratings, 2018), Fitch identifies four factors for the financial profile assessment: a. Asset Quality, b. Earnings and Profitability, c. Capitalisation and Leverage, d. Funding and Liquidity. For each financial profile factor, Fitch uses a core metric and complementary metrics, where core metrics have the greatest relative explanatory power in determining factor scores for banks globally. In the following table the core and the complementary metrics are listed according to Fitch Ratings (2018).

Fitch's Financial Profile Factors' core metric and complementary metrics		
Financial Profile Factor	Core Metric (ratio)	Complementary Metrics
Asset Quality	- Impaired loans / gross loans (%)	- Growth of gross loans (%) - Loan loss allowances/impaired loans (%) - Loan impairment charges/average gross loans (%)
Earnings and Profitability	- Operating profit / risk-weighted assets (%)	- Net interest income/average earning assets (%) - Non-interest expense/gross revenues (%) - Loans and securities impairment charges/pre-impairment operating profit (%) - Operating profit/average total assets (%) - Net income/average equity (%)
Capitalisation and Leverage	- Fitch Core Capital / FCC-adjusted risk-weighted assets (%)	- Basel leverage ratio (%) - Tangible common equity/tangible assets (%) - CET1 regulatory capital ratio (%)

		- Impaired loans less loan loss - allowances/Fitch Core Capital (%)
Funding and Liquidity	- Loans / customer deposits (%)	- Liquidity coverage ratio (%) - Customer deposits/total funding (including preference shares & hybrids; %)
Source: Fitch Ratings (2018)		

Another important change that Fitch Ratings was first to introduce, is the two systemic risk measures to characterise the economic and financial stability of a country. This change took place in 2005 (Fitch Ratings, 2005) and the two systemic risk measures were a system-wide (country-wide) average of individual banks' standalone ratings and an average based on macro-prudential indicators designed to capture abnormal growth of bank credit to the private sector and unusually strong asset price increases. The two systemic risk measures used as input to Fitch's are sovereign ratings rather than directly being used in the stand-alone rating of banks. In this manner, Fitch's all-in ratings indirectly include systemic risk measures, since even though sovereign ratings reflect Fitch's view only on the likelihood of the government servicing its own debt, in practice this is usually closely associated with its broader financial flexibility, and therefore the country's ability to provide support to the banking sector (Fitch, 2018).

Lastly, support ratings (SRs and SRFs) were introduced in 2007 to reflect the likelihood of the bank receiving future extraordinary support by a third party, either the state or an institutional owner (Fitch Ratings, 2011c, 2018). So, clearly support ratings do not express an opinion of a bank's intrinsic credit quality, which is reflected by the VR. SRs incorporate an assessment of a potential supporter's (either a sovereign state's or an institutional owner's) propensity and its ability to support a bank, which is set by the potential supporter's own Fitch long-term IDR. SRs are assigned on a five-point scale, i.e. from 1 to 5, with 1 representing an extremely high probability of support, and 5 indicating that no support can be expected. SRFs are derived directly from the SR and reflect the likelihood a bank will receive extraordinary support specifically from government authorities, i.e. SRFS do not capture the potential for institutional support from the entity's shareholders., SRFs indicate the minimum level to which a bank's Long-Term IDRs could fall if Fitch does not change its view on potential sovereign support. Even though, support ratings definitions have slightly changed in time (Fitch

Ratings, 2011c, 2018), they materially remain the same since they were first introduced. It is indicative to mention that SRFs were originally assigned on the lower case ‘aaa’ rating scale, while they are now assigned on the ‘aaa’ rating scale.

3.2.2. Moody’s Investors Service bank rating methodology

Moody’s Investors Service rating methodology for banks (Moody’s, 2018) is overall similar to that of Fitch as it is comprised of the intrinsic, or standalone, element and the elements of external support. The assessment of the standalone financial strength of a bank is called Baseline Credit Assessment (BCA) and according to this definition measures the probability of default in the absence of any kind of external support. The assessment of external support is based upon the Joint Default Analysis (JDA) framework and it is comprised by the following three elements: a) Affiliate Support, b) Loss Given Failure (LGF) and c) Government Support. Affiliate Support considers the support from affiliated entities, e.g. entities within the same consolidated group, and the outcome of this assessment is the Adjusted BCA that measures the probability of a bank requiring support in order to avoid default (beyond the support provided by its affiliates). The next element is LGF which measures the impact of the failure of the bank, having considered the capacity of affiliate support (i.e. affiliate support having been either denied or exhausted). The last element of external support is Government Support, which is based on the previous element, i.e. the probability of public sector support, the capacity to provide support and lastly the inter-relationship between the public’s body support provider and the bank. From this analysis the result is the long-term local and foreign currency ratings for different instruments ranging from bank deposits to preferred stock.

Moody’s rating framework for banks (Moody’s, 2018) is comprised from the following Issuer Ratings:

- Baseline Credit Assessment (BCA)
- Adjusted Baseline Credit Assessment (BCA)
- Long-Term or short-term Issuer Ratings (Foreign or Domestic)
- Long-Term or short-term Counterparty Risk Rating (Foreign or Domestic)
- Bank Deposit Ratings

The first two ratings were defined above, and the third and the fourth are the all-in ratings assigned to banks according to the above methodology. According

to Moody's (2018), the Issuer Rating is an opinion of the ability of a bank to honour their senior unsecured debt and debt like obligations, while the Counterparty Risk Rating is an opinion of the ability of a bank to honour the uncollateralized portion of non-debt counterparty financial liabilities (CRR liabilities) and also reflect the expected financial losses in the event such liabilities are not honoured. Other bank ratings may be issued for a bank such as the ones mentioned above, i.e. Bank Deposit Rating, which is for the most junior class of uninsured deposits and do not apply to deposits that are subject to a public or private insurance scheme.

A major change in Moody's methodology for banks took place in 2007, just before the beginning of the financial crisis. Moody's in order to encapsulate in its all-in ratings the external support available to banks, introduced a new bank rating methodology (Moody's, 2007a, 2007b, 2007c) called joint default analysis (JDA). This was motivated by studies that showed that the default frequency of banks was consistently lower than that of non-bank corporates with similar ratings. JDA framework at that early stage assessed four types of support: operating parent, cooperative group, regional government, and national government, in order to arrive at all-in ratings or issuer ratings. For each type of support the capacity and willingness to provide support are considered but also the probability that the external support entity is in default when the bank needs support (or the joint default probability). JDA framework evolved in time and as described above and in its present form, as summarised in the beginning of this section.

Moody's direct reaction to the global financial crisis was to recalibrate the relative importance attached to certain rating factors (Moody's, 2009). Throughout the crisis, the willingness of national authorities to provide system-wide support programs, and bank-specific support turned out to be stronger than Moody's had originally expected. As a result, a wider gap existed between all-in and standalone ratings that required some refinements of the weights and relative importance attached to certain rating factors within the existing methodologies.

Moreover, some years later after the Global Financial Crisis, Moody's proceeded with significant proposals in its global bank rating methodology (Moody's, 2014). Among the changes, was the withdrawal of the rating used until then for bank's standalone intrinsic strength, i.e. Bank Financial Strength Ratings (BFSR). BFSR had been refined in 2009 (Moody's, 2009) in the context of calibrating bank ratings due to the Global Financial Crisis, and a mapping was presented form BFSR to BCA. Based on this mapping and further recalibration, Moody's started announcing BCA for banks in 2011. In 2015 BFSR, which used

a less granular scale (from “A” to “E”), was eventually withdrawn and replaced by BCA which used a more granular scale (from “aaa” to “c”). The new standalone rating put greater emphasis on forward looking assessments of bank capital ratios, based on analyses of expected losses for risk assets in stress scenarios.

According to the latest effective methodology for banks by Moody’s (2018), BCA has three sub-components: a) Macro Profile, b) Financial Profile and c) Qualitative Adjustments (Moody’s, 2018). Each sub-component has 2-4 factors and some of the factors have sub-factors. Financial Profile has two factors: Solvency and Liquidity. Solvency has three sub-factors: Asset Risk, Capital and Profitability, while Liquidity has two sub-factors: Funding Structure and Liquid Resources.

Analysing further Financial Profile which represents the relative financial strength of a bank, solvency is the combination of asset risk, leverage and earnings, while liquidity is a bank’s funding profile combined with its ability to access cash. The two factors and the five fundamental credit sub-factors of the Financial Profile are identified with weights and then sub-factors are assigned scores (from “aaa” to “c”) to each of these using historical financial ratios, even though Moody’s considers no single historical ratio or set of such ratios can capture the complexity of a bank’s financial profile. In the following table the factors and sub-factors are listed with their corresponding core metrics/ratios and their other sub-factor metrics.

Moody’s Financial Profile Factors, Sub-factors and Ratios		
Factor / Sub-factor	Core Metric (ratio)	Other Sub-factor Metrics
1. Solvency (total weight 65%)		
a. Asset Risk (weight 25%)	- Problem Loans / Gross Loans and Leases to Customers	- Loan Growth * - Credit Concentration * - Problem Loan and Collateral Coverage * - Long-Run Loan-Loss Performance * - Differences in Problem Loan Recognition - Non-lending Credit Risk - Operational Risk

b. Capital (weight 25%)	- Tangible common equity / risk-weighted assets	-Tangible common equity (TCE) to risk-weighted assets (RWAs) - Nominal Leverage - Regulatory Minimum Requirements - Capital Quality - Capital Fungibility - Access to Capital
c. Profitability (weight 15%)	- Net income / tangible assets	- Earnings Stability
2. Liquidity (total weight 35%)		
a. Funding Structure (weight 20%)	- Market funds / tangible banking assets	- Quality of Market Funding - Quality of Deposit Funding - Term Structure - Market Access -
b. Liquid Resources (weight 15%)	- Liquid banking assets / tangible banking assets	- Quality of Liquid Assets - Intra-group Restrictions
Source: Moody's (2018)		

The core metrics/ratios above are the same as the ones in the framework presented for the revised BCA in 2014 (Moody's, 2014), but substantial differences exist with the equivalent ratios in BFSR (Moody's, 2007a). The most prominent difference is that instead of the sub-factor of Funding Structure in BCA, the sub-factor of Efficiency was considered in BFSR along(?) with core ratio the Cost/Income Ratio.

Lastly, it should be noted that Moody's does not publish a specific summary measure of banking system risk. As a result, Moody's implicitly acknowledges a bank's role) and exposure to systemic risk, which are inputs when estimating the extent of support from national authorities (Moody's, 2018).

3.2.3. Standard & Poor's bank rating methodology

Standard & Poor's methodology for banks (Standard & Poor's, 2011c) is also like the other two CRAs as it is comprised of two elements for intrinsic risk

and for external support. The first element is called the Stand-alone Credit Profile (SACP) and the second Extraordinary or Group Support. Once SACP is determined for a rated bank, the likelihood of extraordinary support is established and an indicative issuer credit rating (ICR) is assigned. The indicative ICR is a component of the ICR, which according to criteria (e.g. comparative analysis of the bank versus banks with similar SACP) may be a notch higher or lower than the indicative ICR.

Overall, Standard & Poor's is the agency that has implemented the most significant revisions to its bank rating methodology since the financial crisis. After a series of proposed revisions in the aftermath of the financial crisis (e.g. Standard & Poor's, 2010a, Standard & Poor's, 2010b and Standard & Poor's, 2011a), the agency published a new rating methodology for banks which is valid until today (Standard & Poor's, 2011c). Since it was first published, there have been only a number of minor updates on the methodology, which mainly remains the same until today.

It should be noted that SACP is not a rating, but a component of the issue rating or issuer credit rating (ICR). So, Standard & Poor's may assign a SACP as a component of a rating to provide information on an issuer's creditworthiness. The SACP is an opinion of an issuer's creditworthiness in the absence of extraordinary support or burden and -similarly to Fitch's standalone metric- it has a lower case scale ('aaa', 'aa+' etc) which parallels the ICR rating scale. The assessment of SACP is based on six factors. The first two factors represent macro analysis (or macro factors) of the creditworthiness of a bank, while the latter four represent microanalysis (or bank-specific factors).

The first two factors are economic and industry risk and they draw from the Banking Industry Country Risk Assessment (BICRA) methodology (Standard & Poor's, 2011b). Those two factors depict the strengths and weaknesses of the operating environment of the entity and set the basis for the SACP. The remaining four factors represent the bank specific strengths and weaknesses such as Business position, Capital and Earnings, Risk Position, and Funding and liquidity.

The Business position factor consists of three subfactors: business stability, concentration or diversity, and management and corporate strategy, which practically assess the qualitative aspects of a bank. The remaining three bank-specific factors are a combination of qualitative and quantitative metrics. In

the following table the key quantitative metrics for the three remaining bank-specific factors are presented.

Standard & Poor's Bank-Specific Factors and Quantitative metrics	
Factor	Quantitative metrics
Capital and Earnings	- risk-adjusted capital (RAC) ratio = Total adjusted capital (TAC*) / Risk-weighted assets (RWAs*) * TAC and RWAs are according to Standard & Poor's definition and calculation
Risk Position	- Management of growth and changes in its risk positions - Impact of risk concentrations or risk diversification - How increased complexity adds additional risk - Whether material risks are not adequately captured by risk-adjusted capital framework (RACF) - Comparative analysis on the current mix of business with those of peers, by comparing a bank's loss experience during past economic downturns
Funding and liquidity	Funding: - loan-to-deposit ratio - long-term funding ratio - reliance on short-term wholesale funding - net stable funding ratio - overall funding mix Liquidity: - liquid assets to wholesale funding - net broad liquid assets to short-term customer deposits - broad liquid assets to short-term wholesale funding - short-term wholesale funding to total wholesale funding
Source: (Standard & Poor's, 2011c)	

What is obvious from the above is that Standard & Poor's, unlikely with the other two CRAs, do not use common financial ratios. Standard & Poor's either use its own metrics as for the Capital and Earnings factor, or a number or ratios or figures for the other two factor, whereas the other two CRAs use one core metric (ratio) and a number of complementary ones.

3.4. Geographical factor in bank credit ratings

In the related empirical literature, the geographical or country factor is found to be important for bank credit ratings. For example, Parker and Tarashev (2011) observe remarkable differences across geographical regions when examining the downgrading of banks in the context of the global financial crisis. The authors find that all three principal CRAs have substantially lowered the ratings of US and European banks relative to the rest of the world regions, i.e. Asia and Pacific. This according to the authors reflects that banks in US and Europe were at the epicentre of the global financial crisis.

In the previous section, we saw that all three principal CRAs incorporate the external support factor, which reflects sovereign's ability and propensity to support a bank. In this context, the starting point to assess the external support factor is the country rating (e.g. Fitch, 2018). However, the inclusion of sovereign ratings in the external support factor of bank credit ratings cannot explain the findings for the geographical factor as in Parker and Tarashev (2011). If the opposite would hold true, there should have been a corresponding lowering or hardening of sovereign ratings as a result of the global financial crisis for the sovereign credit ratings of the US and the European countries, which of course is not the case.

In another study by Salvador, Fernández de Guevara and Pastor (2018), the authors find that the hardening of bank rating policies as a result of the global financial crisis by the three principal CRAs was different depending on the country or geographical area. This is attributed to the fact that factors used as explanatory variables for the adjustment of ratings do not have the same relative importance in all groups of countries. Factors include bank size, loan loss provisions, loans/total assets ratio, etc, but also the sovereign rating. This last finding could only be consistent if the external support factor in the rating methodologies changes as a result of the global financial crisis for some countries or a geographical area. But still, the findings in the aforementioned study concern other variables, so there seems to be a hidden reason behind the country or geographical area factor.

It should be noted that Fitch assigns a country operating environment score for each market in which they rate banks which is one of the five factors of VR (Fitch, 2018). This score derives from two metrics: GDP per capita and the

World Bank's Ease of Doing Business ranking[5]. The implied operating environment score is adjusted for a number of sub-factors: Sovereign Rating, Size and Structure of Economy, Economic Performance, Reported and Future GDP/Capita, Macroeconomic Stability, Level and Growth of Credit, Financial Market Development, Regulatory and Legal Framework, Regional Focus and International Operations. The latter two are bank specific and they may adjust the assigned country score accordingly. Nevertheless, the operating environment in VR, similarly cannot explain the findings for the geographical factor in the related literature as noted above.

A possible explanation for the geographical factor could either be that the three principal CRAs use different calibrations of their rating methodology or have a bias in different geographical areas. It is interesting to know that each of the three principal CRAs breaks down their research departments into a number of offices/areas around the world which are responsible for the research in their region of responsibility. This operating structure in all three CRAs could be the reason behind a different calibration or a bias in the application of bank rating methodologies. For example, Fitch's office in Americas, when assessing a bank's VR may use slightly different regional parameters than Fitch's office in Asia-Pacific.

In the following table the geographical breakdown for the research of each principal CRA is presented.

Structure of world research for the three principal CRAs			
CRA	Fitch	Moody's	Standard & Poor's
Geographical breakdown	- Americas - Asia-Pacifia - Emerging markets - Europe - Middle East and Africa - United States	- Asia Pacific - Europe, Middle East & Africa - Latin America & Caribbean - North America	- Americas - Europe, Middle East & Africa - Asia

[5] Fitch calculates a percentile rank for each country, which is the percentage of all countries (including those with sovereigns not rated by Fitch) with a lower score on the Ease of Doing Business Index

It should be noted that Moody's further breaks down: 1. Asia Pacific into Asia and Pacific Islands, 2. Europe, Middle East & Africa into Africa, Europe and Middle East, 3. Latin America & Caribbean into Caribbean, Central America and South America, and lastly 4. North America into United States, U.S. territories, Canada and Bermuda. Standard & Poor's also further breaks down: 1. Americas into Americas and Latin America (Spanish and Portuguese), 2. Europe, Middle East & Africa into Europe, Maalot and Russia, and 3. Asia into Australia/New Zealand, Asia and Japan.

4: Empirical Analysis

4.1. Introduction

In this part we proceed first with the empirical strategy and then with the presentation of our dataset. Next, we review econometric issues that have to be taken into account. In the fourth part we proceed with the empirical strategy and results, together with our structural break tests, and finally we conclude with robustness tests.

4.2. Empirical Strategy

The aim of this study is to identify time-series variation in bank credit rating standards. As mentioned earlier, the methodology used is close to the work of Alp (2013), which in turn is based on Blume, Lim, and Mackinlay (1998). Both Blume, Lim, and Mackinlay (1998) and Alp (2013) also uses an ordered probit model to study rating standards of rating by S&P as a function of firm characteristics and year indicator variables. Year indicator variables in both studies are used to capture the time-series variation in credit rating standards that it is not captured by the other variables in the ratings equation.

Our analysis will also use an ordered logit model to study credit ratings standards of commercial banks for a period that starts from the late 1980s until year 2015. Bank credit ratings are modelled as a function of financial explanatory variables that will be presented in subsection 4.3.3, and year indicator variables. Year indicator variables used in Alp (2013) and Blume, Lim, and Mackinlay (1998) capture stringency or loosening of rating standards relative to the first year in their equivalent samples (1985 and 1978), i.e. the first year of the sample in each study is the reference year. As noted in Alp (2013), this is a narrow definition stringency since the question is formulated as if a firm holding the same risk characteristics receives a higher or lower rating using the model used in 1985.

In our sample, which is analysed in the following section, credit ratings start from year 1986 with scarce observations before 1990 and few observations before 2000. Also, most of the observations before 1990 are not accompanied d by financial data (i.e. there are a lot of missing financial variables or no financial variables in quarters before 1990). It is indicative to mention that for Fitch the sum of all available bank credit ratings up to year 1999 is approximately 600 compared

to the 625 bank credit ratings of year 2000. So, we use a broader definition of stringency which dictates that if rating agencies use the same model until 1999 to rate banks, the question is whether a bank, having the same risk characteristics receives a better or worse credit rating from year 2000 and on. All years until 1999 are represented as one and thus year indicator variables capture stringency or loosening of rating standards from 2000 until 2015. So, if rating agencies use the model they used up until 1999 to assign ratings after this year, we study whether a commercial bank having the same characteristics receives a higher or lower rating. Higher ratings imply a comparative loosening of rating standards, while lower rating imply stringency.

The ordered logit model used in our analysis can be broken down into two parts. The first part corresponds to the 17 rating categories, according to the rating transformation presented in subsection 4.3.1.1 below (also see Table 4.2). The dependent variable, R_{it} denotes the credit rating of bank *i* at quarter *t* according to the latent variable Z_{it} and the partition points μ_i distinguish each rating category as follows:

$$R_{it} = \begin{cases} 17 & \text{if } Z_{it} \in [\mu_{16}, \infty) \\ 16 & \text{if } Z_{it} \in [\mu_{15}, \mu_{16}) \\ 15 & \text{if } Z_{it} \in [\mu_{14}, \mu_{15}) \\ \vdots & \\ 3 & \text{if } Z_{it} \in [\mu_2, \mu_3) \\ 2 & \text{if } Z_{it} \in [\mu_1, \mu_2) \\ 1 & \text{if } Z_{it} \in (-\infty, \mu_1) \end{cases} \quad (1)$$

The second part, relates the latent variable to the explanatory variables:

$$Z_{it} = a_t + \beta' X_{it} + \varepsilon_{it} \quad (2)$$

where Z_{it} is the latent variable of bank *i* at quarter *t*, as already mentioned, a_t is the intercept for quarter *t*, β is the vector of slope coefficients, and X_{it} is vector of the explanatory variables of bank *i* at quarter *t*. In vector X_{it} the included financial explanatory variables are the values observed at quarter *t-1*. In this way, credit ratings are regressed on the previous quarters' financial data, or on the data available up to the fourth quarter of the previous year as explained above. We adopt this formulation because we assume the CRAs, first receive the publicly

available information of a bank and then decide on the bank's credit rating. For example, year-end financial results are announced in the beginning of the following year, e.g. the results of 2018 are announced within the first quarter of 2019 (usually from early February till mid-March), so the credit ratings observed at the end of the first quarter of 2019 should include the year-end information of 2018, which are the previous quarter's published values. This approach is similar to Baghai, Servaes, and Tamayo (2014), which using annual data, consider the first rating available three months after the fiscal year-end and match this rating with the fiscal year-end financial statement data. This three-month lag is to ensure that the financial data are available to the rating agencies at the time the rating is issued. In a similar fashion, Alp (2013), who estimates a model with yearly variables, uses the calendar year-end values of the ratings and match them with financial data available before the year-end.

4.3. Data

Our data consists of a worldwide panel of 1,208 commercial banks with their equivalent credit ratings by Fitch, Moody's and S&P. The financial database used to collect bank credit ratings and financial data is Bankscope by Bureau Van Dijk.

4.3.1. Bank Selection in Bankscope

The selection criteria used in Bankscope to construct our sample of banks with credit ratings from the three CRAs are bank's specialisation, size and whether the bank considered is the ultimate owner in the ownership structure. For the specialisation criterion we consider values of Commercial Banks, Savings Banks, Cooperative Banks and Bank Holding & Holding Companies (BH&HCs)[6]. The reason for this selection is to maintain a homogeneity in our sample concentrating on commercial banks that play a fundamental role in the economy, i.e. their function is vital for economic development and growth. For the size criterion we consider banks that had book value of assets greater or equal to $5bill. in 2006 (i.e. the year before the global financial crisis begun) or in the last year that a

[6] Many banks from the initial sample were excluded "by hand" because even though they were as BH&HCs in Bankscope, they were not commercial banks (e.g. Citigroup Inc and Goldman Sachs Group, Inc in the US are both characterised as BH&HCs in Bankscope, but the former is a commercial bank and is retained in the sample while the latter is an investment bank and excluded from the sample).

bank's data are available. The reason for the size criterion is to have a sample that will account for most of the global banking system (i.e. at least 90% of the total book value of assets of the global banking system[7]), while not take into account smaller banks that are normally not rated. Lastly, the use of the ultimate owner criterion is to avoid double-counting ratings of banks that are junior within a single ownership structure (e.g. while Banco Santander SA is included as the ultimate holder in the Santander Group, all its subsidiaries such as Santander UK Plc are excluded).

4.3.2. Bank Credit Ratings

The measures of credit ratings used in our dataset are the long-term issuer ratings of each CRA which is what is mostly used in literature (Alp, 2013; Hau, Langfield and Marques-Ibanez, 2012; Van Laere, Vantieghem and Baesens, 2012) as they are the primary issuer ratings of each CRA and are considered to represent opinions of creditworthiness through the business cycle rather than short-term fluctuations (Moody's, 2018; Kiff, Kisser and Schumacher, 2012). Specifically, the credit ratings we use are the long-term issuer default rating (IDR) for Fitch, the long-term Issuer rating (foreign) for Moody's and the foreign currency long-term Issuer Credit Rating (ICR) for S&P. Credit ratings are recorded at the end of each quarter thus constituting a time series of quarterly data.

In the end, we obtain an unbalanced panel of approximately 90,000 quarterly bank ratings from 1987[8] to 2015. Bank ratings are distributed among the three CRAs as follows: 30,173 quarterly bank ratings by Fitch, 31,161 quarterly bank ratings by Moody's and 28,445 quarterly bank ratings by Standard and Poor's. Table 4.1 shows the distribution of our full world sample per World Region and CRA.

[7] In Ellul and Yerramilli (2010) their sample is comprised by the 100 largest Bank Holding Companies (BHCs) in the US, with respect to the book value of their total assets at the end of 2007. Although the BHCs in the US were over that 5,000 by the end of 2007, the sample of the 100 largest BHCs in Ellul and Yerramilli (2010) accounts for approximately 92% of the total book value of assets in the US banking system. So, given our size criterion our US sample is comprised of the 260 largest commercial banks in the US, which should account for more than 90% of the total book value in US banking system.

[8] Our initial sample contained 76 additional quarterly bank credit ratings from 1980 to 1986, but they were dropped out because no financial variables existed in Bankscope for that period.

Table 4.1: Credit Ratings per World Region/CRA

World Region	Fitch	Moody's	S&P	Grand Total
Europe	13,335	12,941	11,850	24,791
US & Canada	6,635	7,246	7,734	21,615
RoW	9,903	10,974	8,861	29,738
	30,173	31,161	28,445	89,779

4.3.1.1. Rating Transformation

All credit ratings obtained are transformed from their letter form into a numerical value that corresponds to an ordinal scale ranging from 1 to 17, according to Table 4.2. Value of 1 corresponds to the lowest rated banks (CCC+/Caa or worse) and value of 17 to the highest rated banks (AAA/Aaa), according to Table . This transformation is same as in Alp (2013), Shen, Huang and Hasan (2012) and Van Laere, Vantieghem and Baesens (2012)[9], where an ordinal scale of 17 numbers is also used and the lowest ratings (CCC+/Caa or worse) are pooled in one category because of their limited numbers of institutions in each of the categories.

[9] In Alp (2013) and Shen, Huang and Hasan (2012) number 17 corresponds to the highest credit rating, while in Laere, Vantieghem and Baesens (2012) the opposite is true, i.e. number 1 corresponds to the highest credit rating.

Table 4.2: Rating Transformation Table

Fitch	Rating Scale Number	Moody's	Rating Scale Number	S&P	Rating Scale Number
AAA	17	Aaa	17	AAA	17
AA+	16	Aa1	16	AA+	16
AA	15	Aa2	15	AA	15
AA-	14	Aa3	14	AA-	14
A+	13	A1	13	A+	13
A	12	A2	12	A	12
A-	11	A3	11	A-	11
BBB+	10	Baa1	10	BBB+	10
BBB	9	Baa2	9	BBB	9
BBB-	8	Baa3	8	BBB-	8
BB+	7	Ba1	7	BB+	7
BB	6	Ba2	6	BB	6
BB-	5	Ba3	5	BB-	5
B+	4	B1	4	B+	4
B	3	B2	3	B	3
B-	2	B3	2	B-	2
CCC+	1	Caa1	1	CCC+	1
CCC	1	Caa2	1	CCC	1
CCC-	1	Caa3	1	CCC-	1
CC	1	Ca	1	CC	1
C	1	C	1	C	1
RD	1			R	1
D	1			SD	1
				D	1

By and large in the related literature, we usually find the transformation of credit ratings to an ordinal numerical scale of consisting of no more than 10 categories. Blume, Lim, and Mackinlay (1998) use an ordinal scale of 4 categories to map the 4 investment grade rating categories (AAA, AA, A and BBB) of S&P bond-level ratings of US corporations. Amato and Furfine (2004) use an ordinal scale of 8 categories to map the 8 upper rating categories (AAA, AA, …, CC) of S&P corporate ratings of US firm.Finally , Salvador, Fernández de Guevara and Pastor (2014) use an ordinal numerical scale of 6 categories to map all rating categories of Spanish bank credit ratings by the three principal CRAs, an in a companion paper the sme authors Salvador, Fernández de Guevara and Pastor (2018) use an ordinal numerical scale of 11 categories to map ratings from all three principal CRAs, and group in a single category the lowest notches that contain only a small number of observations.

The reason for using an ordinal scale of 17 numbers instead of a more restricted scale that most studies in related literature use, is that our sample is

large compared to the available data in the previous studies. The choice of 17 categories is comparable to the of studies mentioned in the beginning that have comparable sample sizes (e.g. more than 20,000 observations).

4.3.1.2. Ratings Summary Statistics

Table 4.3 presents the basic summary statistics for the bank credit ratings by each CRA for the world sample and for each world region separately.

Table 4.3: Summary Statistics for Bank Credit Ratings

	Fitch			Moody's			S&P		
	Mean	Std Dev	Obs	Mean	Std Dev	Obs	Mean	Std Dev	Obs
World Sample	9.23	3.32	30,173	9.71	3.62	31,161	9.72	3.22	28,445
Europe	10.08	3.17	13,335	10.35	3.57	12,941	10.63	3.15	11,850
US & Canada	9.66	3.16	6,935	10.83	2.93	7,246	9.92	2.80	7,734
RoW	7.78	3.15	9,903	8.21	3.61	10,974	8.32	3.16	8,861

Some interesting remarks can be made from the table above. Fitch on average assigns lower ratings compared to Moody's and S&P. This can be attributed to the lower ratings Fitch assigns to each of the three world regions compared again to Moody's and S&P. Also, Fitch assigns lower ratings to each world region separately compared to Moody's and S&P. Moody's assigns the highest ratings to US & Canada banks and S&P assigns the highest ratings to European and RoW banks. The final observation from the presented statitics is that European and US & Canada banks receive significantly higher ratings compared to RoW banks for all three CRAs.

In Table 4.4 we present again the basic statistics for the bank credit ratings by each CRA for the world sample and for each world region separately, but for different periods. We have chosen to report them over, two pre-crisis periods, i.e. 2000-5 and 2006-8 and the period after the global financial crisis 2009-15. The period before 2000 is ignored as observations are really scarce before 1990 and only few observations before 2000. The pre-crisis period is split into two subperiods because we believe it is interesting to see how CRAs may have assigned on average higher ratings just before the crisis begun (which is more observable in the analysis presented in the next sub-section). For the period after

the global financial crisis we expect a decrease in the average ratings assigned to banks.

Table 4.4: Summary Statistics for Bank Credit Ratings for different periods

2000-5	Fitch			Moody's			S&P		
	Mean	Std Dev	Obs	Mean	Std Dev	Obs	Mean	Std Dev	Obs
World Sample	9.35	3.44	8,409	10.31	3.22	7,878	9.91	3.21	7,678
Europe	10.06	3.62	3,361	11.55	2.43	2,906	11.07	3.09	3,028
US & Canada	10.18	2.57	2,750	11.11	2.62	2,717	10.11	2.59	2,741
RoW	7.33	3.24	2,298	7.75	3.32	2,255	7.80	3.18	1,909
2006-8	Fitch			Moody's			S&P		
	Mean	Std Dev	Obs	Mean	Std Dev	Obs	Mean	Std Dev	Obs
World Sample	9.54	3.12	6,753	10.12	3.72	6,245	10.01	3.06	5,595
Europe	10.52	3.03	2,820	11.32	3.20	2,857	11.11	2.67	2,300
US & Canada	9.84	2.94	1,559	11.28	2.73	1,175	10.26	2.90	1,365
RoW	8.17	2.83	2,374	7.97	3.83	2,213	8.53	3.02	1,930
2009-15	Fitch			Moody's			S&P		
	Mean	Std Dev	Obs	Mean	Std Dev	Obs	Mean	Std Dev	Obs
World Sample	8.93	3.33	14,415	8.90	3.73	14,422	9.05	3.25	12,446
Europe	9.86	2.99	6,831	9.17	3.83	6,517	9.73	3.27	5,458
US & Canada	8.71	3.70	2,386	9.55	3.35	2,053	8.90	3.04	2,267
RoW	7.81	3.22	5,198	8.37	3.68	5,852	8.34	3.17	4,721

The results in the table above are close to what was expected. All CRAs' ratings exhibit an increasing tendency in the periods 2006-8, just before the onset of the crisis compared to the 2000-5 period. This is more pronounced as Fitch and S&P on average assign slightly higher ratings for the period 2006-8 (just before the global financial crisis begun). Not surprisingly all CRAs assign lower ratings in the period after the global financial crisis 2009-15.

4.3.3. Control Data

Rating agencies face many difficulties in the process of assessing banks' creditworthiness due to the unique features of the banking industry. Moreover, there is evidence that agencies disagree more about bank ratings than for corporate ratings, because banks are inherently more opaque (Morgan, 2002) So, assessing bank ratings is an even more difficult task to perform, which means choosing the most appropriate explanatory variables is crucial to our purpose.

4.3.3.1. Financial Explanatory Variables

In the process of assessing a bank's rating we first must assess the intrinsic, or standalone, creditworthiness element of a bank as analyzed in the previous essay for rating methodologies. For this reason, we choose six key financial characteristics variables that are mostly used in the literature and also are related to the CRAs' financial profile factors presented in subsections 3.2.1, 3.2.2 and 3.2.3. Those financial characteristic variables cover bank size, profitability, leverage, asset structure, funding structure and trading share.

Bank size is measured by the natural log of total assets, which is found in almost all relevant literature (Erkens et al, 2012, Laeven and Levine, 2009, Ellul and Yerramilli, 2010, Hau, Langfield and Marques-Ibanez, 2012, Van Laere, Vantieghem and Baesens (2012), etc). Size is a very important factor because it relates to the external support element of all three principal CRA methodologies. This is also noted in related literature (Caporale et al., 2011; Shen et al., 2012), and the assumption is that greater size implies greater likelihood of external support from authorities in the event of the bank encountering problems. A secondary element of size is that as bank size increases their opaqueness increase and thus it is more difficult to rate it. Profitability is measured by Return on Average Assets (ROAA)[10] which is also a commonly used variable in the relevant literature (Erkens et al, 2012; Ellul and Yerramilli, 2010, Hau, Langfield and Marques-Ibanez, 2012, etc). Leverage is measured by Total Assets divided by Equity[11], also found in Hau, Langfield and Marques-Ibanez (2012) and Van Laere, Vantieghem and Baesens (2012), where the inverse ratio is used (Common equity to total assets). Asset structure is measured by both Net Loans divided by Total Assets and Net profits on trading and derivatives divided by Total

[10] Alternatively, Net Income to equity or Profits/Assets are also used in similar literature.
[11] Alternative measures for leverage found in similar literature are Total liabilities divided by total assets (Erkens et al, 2012) and Ratio of Tier1 capital to assets (Ellul and Yerramilli, 2010).

Assets, something found in Hau, Langfield and Marques-Ibanez (2012) which aims to capture the traditionally more stable activity of granting loans versus the less predictable financial market activity. Lastly, funding structure is measured by Short-term Funding divided by Total Assets also as in Hau, Langfield and Marques-Ibanez (2012).

All financial variables are also collected from Bankscope on a quarterly basis. If no data is available for a specific quarter, we assume as valid value the value from the previously available quarter, but up to the fourth quarter of the previous year. This is because if no quarterly data is available then we either have data for only for the fourth quarter or semi-annual data (i.e. only for the second and fourth quarter). For example, if we have annual data, the values for the first, second and third quarter are assumed the value of the previous year's fourth quarter (or end of year financial data values). If we have semi-annual data, the value for the first quarter is assumed the value of the previous year's fourth quarter, and the value of the third quarter is assumed the value of the second quarter.

In this way, since in our empirical strategy (see section 4.2) the quarterly value of the bank credit rating is at quarter *t* and the financial explanatory variables at quarter *t-1*, credit ratings are regressed on the previous quarters' financial data, or on the data available up to the fourth quarter of the previous year as explained previously. With respect to the consolidation level for the financial data, in Bankscope the available data is at consolidated or unconsolidated level, with further categorization[12]. In line with the three principal CRAs (Fitch, 2018; Moody's 2018; Standard & Poor's, 2011c), if at the same quarter data exists at both consolidated and unconsolidated level, we choose the data at consolidated level data for our analysis. When no data exists at the consolidated level, we choose the data at unconsolidated level. Such cases are for the years prior to 2000 or of banks that are solo entities (with no subsidiaries).

[12] The following consolidation codes are found in Bankscope:
C1: statement of a mother bank integrating the statements of its controlled subsidiaries or branches with no unconsolidated companion.
C2: statement of a mother bank integrating the statements of its controlled subsidiaries or branches with an unconsolidated companion.
C*: Additional Consolidated statement (IFRS).
U1: statement not integrating the statements of the possible controlled subsidiaries or branches of the concerned bank with no consolidated companion.
U2: statement not integrating the statements of the possible controlled subsidiaries or branches of the concerned bank with an consolidated companion.
U*: Additional Unconsolidated statement (IFRS).

Lastly, we choose not to winsorize any of the financial control variables, an approach that is sometimes found in related literature in order to rule out outliers and mitigate their impact on the results. For example, Alp (2013), Baghai, Servaes, and Tamayo (2014), and Salvador, Fernández de Guevara and Pastor (2018) winsorize all continuous financial explanatory variables but in different ways[13]. We decide not to proceed with winsorizing as the regression results hardly differentiate when we attempt to do so.

4.3.3.2. Year Effects

Year effects are key for the purpose of this study. We use year dummy variables to capture year effects which is a common practice in all related literature that examines the time-series variation in rating standards. Blume, Lim, and Mackinlay (1998), Jorion, Shi, and Zhang (2008), Alp (2013) and Baghai, Servaes, and Tamayo (2014) all use year dummies to capture year effects. In this way, year indicators are used to capture the tightening (or stringency) and the loosening or of the rating standards relative to the omitted year, which is in most cases the first year in the sample used. As we already explained in subsection 4.2, we use a broader definition of stringency so that all years until 1999 are represented as one and thus year indicator variables capture stringency or loosening of rating standards from 2000 until 2015.

4.3.3.3. Other Explanatory Variables

Apart from the financial control variables described above which relate to the intrinsic risk of a bank, the other major element of bank credit ratings as described in Section 3 is the external support element. This is defined by Fitch as the Support Rating and the Support Rating Floor, by Moody's as the Affiliate Support, the Loss Given Failure and the Government Support, and lastly by Standard & Poor's as the Extraordinary or Group Support. Regardless of the different definitions of the external support element, it is in mainly about the ability and likelihood of government or sovereign support to a bank for all three CRAs. So, for this common element in the methodology of all three CRAs, we consider that it can be best proxied by country sovereign credit ratings. In this way, for all banks we obtain their country's sovereign credit rating by the same CRAs and the equivalent time periods (i.e. if we have a bank credit for a bank at period *t* by Fitch,

[13] Alp (2013) winsorize all continuous variables at 1% and 99%, Baghai, Servaes, and Tamayo (2014) winsorize all explanatory variables: all variables at 99th percentile and some at the 1st percentile, while Salvador, Fernández de Guevara and Pastor (2018) winsorize the explanatory variables at 1% and 99%.

we obtain the bank's country credit rating again for period *t*), and the country ratings are similarly transformed from their letter form into a numerical value that is corresponds to the same ordinal scale ranging from 1 to 17. The source of sovereign credit ratings is again Bankscope.

A note should be made that the use of sovereign credit ratings as an explanatory variable is not often found in related literature. However, the sovereign crisis in the Eurozone Countries uncovered how a country's banks are strongly related to the creditworthiness of the country, and vice versa (BIS, 2011). Studies such as Huang and Shen (2015) highlight the importance of sovereign credit ratings on bank credit ratings, while also find evidence of an asymmetric impact of sovereign credit ratings on bank credit ratings. Also, in studies where an international sample of bank ratings is analysed what is usually found is country fixed effects act as a proxy of the economic environment on bank credit ratings (e.g. Hau, Langfield and Marques-Ibanez, 2012, Iannotta, Nocera and Sironi, 2013, etc). Similarly, in Caporale, Matousek and Stewart (2011) and in Caporale, Matousek and Stewart (2012) a country index is developed to reflect cross-country differences as it would not be feasible to estimate their model using country fixed effects because of the 90 countries in their sample.

Yet, in section 3 we clearly observed that it is not the economic environment per se that is taken into account by the three principal CRAs as the external support element. For example, Fitch includes systemic risk measures in sovereign ratings and thus they indirectly incorporate them in the stand-alone rating of banks through the sovereign ratings. So, including country fixed effects as a proxy of the economic environment while not taking into account the sovereign credit rating appears not to be in line the three principal CRAs' methodologies. Two of the rare case of studies that sovereign credit ratings are used as an explanatory variable are Salvador, Fernández de Guevara and Pastor (2018), where the authors also include GDP growth rate as a measure of the economic environment, and Van Laere, Vantieghem and Baesens (2012).

Lastly, the last explanatory variable used in our regressions is a dummy called Multiple Rating Dummy and aims to capture the effect of the level of competition among the three CRAs, if any exists. According to the literature of industrial organization the role of competition is positive for product quality. So, we would expect that rating competition could provide the rating agencies with incentives to improve their rating process and methodology in order to acquire a good reputation for accurate ratings. Nevertheless, Becker and Milbourn (2010)

claim that the entry of Fitch in CRAs' market in late the 1990s led to deterioration in ratings' quality. Such a phenomenon is attributed to another channel of rating competition: higher competition among rating agencies can lead to a reduction of quality in order to induce rating shopping (Bolton, Freixas and Shapiro, 2012). In another context, Bongaerts, Martijn Cremers, and Goetzmann (2012) examine three existing theories about multiple ratings: information production, rating shopping, and regulatory certification, to infer about the economic role credit rating agencies play in the corporate bond market. Under the information production theory, investors are averse to uncertainty and shopping extra ratings reduces their uncertainty. Under the rating shopping theory, issuers shop for an additional rating hoping to improve their existing rating. And under the regulatory certification theory, market and regulatory forces create the need to separate issues, so that speculative-grade ratings (the weaker ones) need a third rating. These theories are not mutually exclusive. But, given the scope of this essay, we chose not to broaden the measures used in our analysis for competition. So, similar to Hau, Langfield and Marques-Ibanez (2012) our Multiple Rating Dummy takes the value of 1 whenever for the given period another rating agency has issued a rating for a particular bank, and 0 otherwise.

4.4. Econometric Issues

In this section, we examine various econometric issues before we set out the estimation of the econometric model.

4.4.1. Unbalanced Panel Data

We are using a panel data (also known as longitudinal or cross-sectional time-series data) since the behaviour of entities of banks are observed across time. Panel data enjoy great advantages in controlling for individual heterogeneity and acquiring more reliable estimates from a larger data set with more variability and less collinearity (Baltagi and Song, 2006). However, panel data is subject to problems arising from sample selection, which include nonresponse in both cross-sectional and time series data sets. In our case we have an unbalanced panel data since some observations in time periods are missing for some banks (Greene and Hensher, 2009). Our sample covers a total of 117 quarters, however with significant gaps since hardly any bank has credit ratings for the full time period. Moreover, some banks are liquidated or taken over during the sample period, or for other banks CRAs are withdrawn, while some information (financial data) is

missing just due to recording errors. This randomly missing data may not cause inconsistent estimation, leading us to false inference (Greene and Hensher, 2009).

4.4.2. Fixed Effects vs Random Effects

Since we have panel data, there is bound to be heterogeneity among individual units of banks and persistence due to the time series character of the data. So, our panel data poses several estimation and inference problems that need to be addressed by adopting the appropriate estimation technique. We begin by a discussion of the choice between techniques are the fixed effects (FE) and the random effects models (RE).

A note should be made that with panel data, we can include variables at different levels of analysis that in our case would mean banks, countries, or world regions. The most appropriate level of analysis seems to be banks, since for the country and world region effects our data are included in country ratings.

In the FE model, we are interested in analysing the impact of variables that vary over time and thus try to capture the causes of changes within an entity. We assume that something within the entity may impact or bias (the independent or dependent variables and we need to control for this. This is the rationale behind the assumption of the correlation between entity's error term and independent variables. In FE model, the intercept is allowed to differ among entities in recognition of the fact that each entity may have some special characteristics of its own. A time-invariant characteristic could not cause such a change, because it would have been constant for each entity. In the RE model, the variation across entities is assumed to be random (a random drawing from a much larger population with a constant mean value) and uncorrelated with the independent variables included in the model. In other words, the RE model it is not about the variation is stochastic or not. The RE model should be used when differences across entities can have impact on the dependent variable only and being uncorrelated (or statistically independent) with all the independent variables.

To sum up the above, RE model assume that the entity's error term is not correlated with the independent variables which allows for time-invariant variables to play a role as explanatory variables. So, an advantage of RE model is that you can include time invariant variables (i.e. gender), whereas in the FE model these variables are absorbed by the intercept. However, in the RE model we need to specify those individual characteristics that may or may not influence the

independent variables. The problem with this is that some variables may not be available therefore leading to omitted variable bias in the RE model. Also, when the number of cross-sectional entities is large, and the number of time periods is short (i.e. having a short panel), the appropriateness of each model is based on whether we can safely assume that the cross-sectional entities in our sample are random drawings from a larger sample or not.

In our case, our sample has a large number of cross-sectional entities with relatively small number of time series data. This means that the estimates obtained by each of the two methods can differ significantly and thus the appropriate method should be carefully selected. The key is whether the individual, or cross-sectional entities, i.e. banks, in our sample are random drawings from a larger sample or not. Our sample consists of approximately the 1.200 largest banks around the world, which means that our sample is not a random drawing and thus the RE model seems inappropriate. Moreover, if we chose the RE model it would be extremely difficult to specify the missing variables that affect the independent variables, leading us to omitted variable bias in the model. So, the appropriate estimation technique seems to be the FE model. However, since we are not using OLS, using FE in an ordered logit model could create problems due to the consistency of estimators. For this reason we decide to use the Huber–White robust estimator clustered at the bank level also used in Alp (2013), in order to obtain a robust variance estimate that adjusts for within-cluster correlation.

4.5. Empirical Results

In this section we proceed with the empirical results. First, we estimate the model for the full world sample of banks, and then we estimate the model for separate world regions. In the following subsection, we then proceed with structural break tests equivalently for the full world sample and for the three world regions.

4.5.1. Results with full world sample

In this sub-section we estimate the ordered logit model of equations (1) to (2) for the full world sample of banks. Tables 4.5a, 4.5b and 4.5c show the coefficient estimates for the full world sample for using the ratings of Fitch, Moody's and S&P. The coefficients of Log of Assets and R.O.A.A. are all significant and have the same sign, as expected according to literature and expectations. For the rest of the financial characteristics the results are less straightforward for the full world sample. The coefficient of Total Assets/Equity has a negative sign as expected, for both the Fitch and the S&P, but it is not significant for the Moody's. Similarly Net Loans/Total Assets coefficient has a negative sign for Fitch as expected, but is not significant neither for Moody's or S&P. The coefficient of Deposits&Short-term Funding/Total Assets has a negative sign for Fitch and is not significant for Moody's and S&P. Other operating income/Average Assets coefficient has negative sign as expected, for both Moody's and S&P but is not significant for Fitch

Aside from the financial characteristics include above, our model incorporates the rest of the explanatory variables described in the previous section. The Country Rating coefficient has a positive sign and is significant for all three CRAs. The positive sign for the Country Rating coefficient for all three CRAs accompanied by the high significance levels (Z

Table 4.5a: Estimation results for Fitch / full world sample

Estimation results for the ordered logit model for the full world sample of commercial banks. The dependent variable is the **Fitch** long-term issuer default rating converted into an ordinal scale ranging from 1 to 17, whereas CCC+ or worse corresponds to 1 and AAA corresponds to 17. The explanatory variables are defined in the previous section. Standard errors are calculated using cluster-correlated robust estimate of variance at the bank level, and the asterisks *, **, and *** next to the coefficients values respectively correspond to significance levels 10%, 5% and 1%.

Variable	Coefficient	Z stat	$\frac{\text{Coefficient} \times \text{SD}}{\text{Rating Notch Length}}$	$\frac{\text{Coefficient}}{\text{Rating Notch Length}}$
Log of Assets	1.1130 ***	11.26	0.7292	
R.O.A.A.	0.1029 ***	2.75	0.2004	
Total Assets/Equity	-0.0001 ***	-9.37	-0.0160	
Net Loans/Total Assets	-0.0118 ***	-3.26	-0.1840	
Dep.&Funding/Total	-0.0016 ***	-3.53	-0.1605	
Other Op. Income/Avg	-0.0587	-1.39	-0.1142	
Country Rating	0.4868 ***	19.67	1.8747	
Multiple rating dummy	0.3996 ***	2.76		0.3730
Year Indicators				
2000	-0.4166 **	-2.38		-0.3888
2001	-0.4671 ***	-3.17		-0.4359
2002	-0.6198 ***	-4.50		-0.5785
2003	-0.8779 ***	-6.47		-0.8194
2004	-0.9042 ***	-6.91		-0.8440
2005	-0.9162 ***	-7.11		-0.8552
2006	-0.9194 ***	-7.16		-0.8582
2007	-0.8910 ***	-7.17		-0.8317
2008	-1.0046 ***	-7.86		-0.9377
2009	-1.1455 ***	-8.67		-1.0691
2010	-1.0591 ***	-8.08		-0.9885
2011	-1.0229 ***	-7.39		-0.9547
2012	-1.1139 ***	-7.38		-1.0397
2013	-1.1685 ***	-7.57		-1.0907
2014	-1.1991 ***	-7.75		-1.1192
2015	-1.1047 ***	-6.69		-1.0311
No. of	26,547			
Pseudo R^2	0.184			
Clusters of Banks	777			

stats) is indicative of the importance in determining a bank's credit rating. Multiple rating dummy coefficient has positive sign and significance for Fitch but is not significant for both the Moody's and S&P sample. This as a noteworthy finding for the ratings competition, i.e. Fitch gives higher credit ratings when at least one of the other two CRAs have also rated a particular bank at the same quarter, an inference which does not hold for the other two CRAs.

Table 4.5b: Estimation results for Moody's / full world sample

Estimation results for the ordered logit model for the full world sample of commercial banks. The dependent variable is the M**o**ody's long-term Issuer rating (foreign) converted into an ordinal scale ranging from 1 to 17, whereas Caa1 or worse corresponds to 1 and Aaa corresponds to 17. The explanatory variables are defined in the previous section. Standard errors are calculated using cluster-correlated robust estimate of variance at the bank level, and the asterisks *, **, and *** next to the coefficients values respectively correspond to significance levels 10%, 5% and 1%.

Variable	Coefficient	Z stat	$\frac{\text{Coefficient} \times \text{SD}}{\text{Rating Notch Length}}$	$\frac{\text{Coefficient}}{\text{Rating Notch Length}}$
Log of Assets	1.0334 ***	9.08	0.7936	
R.O.A.A.	0.2104 ***	4.26	0.4944	
Total Assets/Equity	-0.0025	-1.33	-0.8374	
Net Loans/Total Assets	0.0062	1.46	0.1227	
Dep.&Funding/Total	-0.0000	-1.53	-0.0389	
Other Op. Income/Avg	-0.1431 ***	-3.78	-0.4036	
Country Rating	0.4801 ***	19.26	2.2366	
Multiple rating dummy	-0.1276	-0.93		-0.1498
Year Indicators				
2000	-0.4020 **	-2.30		-0.4720
2001	-0.5142 **	-2.54		-0.6037
2002	-0.5386 **	-2.43		-0.6324
2003	-0.5256 **	-2.21		-0.6171
2004	-0.6386 ***	-2.65		-0.7498
2005	-0.6856 ***	-2.82		-0.8050
2006	-0.6861 ***	-2.72		-0.8056
2007	-0.1208	-0.46		-0.1419
2008	-0.2054	-0.77		-0.2412
2009	-0.4480 **	-1.65		-0.5260
2010	-0.6064 **	-2.25		-0.7120
2011	-0.8512 ***	-3.22		-0.9994
2012	-1.1454 ***	-4.31		-1.3448
2013	-1.2811 ***	-4.81		-1.5042
2014	-1.3658 ***	-5.15		-1.6037
2015	-1.2074 ***	-4.56		-1.4176
No. of	22,298			
Pseudo R^2	0.171			
Clusters of Banks	746			

Lastly, the Year indicator coefficients, which are the epicentre of this study, also give noteworthy results. We observe that all year indicator coefficients for all three CRAs have negative signs, and most of them are statistically significant. Negative signs can be interpreted that rating standards from 2000 until 2015 have become more stringent relative to the period until 1999.

All the coefficient estimates of the ordered logit model in our analysis described above are informative with respect to their signs, but they are uninformative with respect to the magnitude they affect credit ratings, thus making it difficult to infer changes in the

Table 4.5c: Estimation results for S&P / full world sample

Estimation results for the ordered logit model for the full world sample of commercial banks. The dependent variable is the S&P foreign currency long-term rating converted into an ordinal scale ranging from 1 to 17, whereas CCC+ or worse corresponds to 1 and AAA corresponds to 17. The explanatory variables are defined in the previous section. Standard errors are calculated using cluster-correlated robust estimate of variance at the bank level, and the asterisks *, **, and *** next to the coefficients values respectively correspond to significance levels 10%, 5% and 1%.

Variable	Coefficient	Z stat	$\frac{\text{Coefficient} \times \text{SD}}{\text{Rating Notch Length}}$	$\frac{\text{Coefficient}}{\text{Rating Notch Length}}$
Log of Assets	0.6431 ***	6.06	0.4786	
R.O.A.A.	0.1982 ***	3.75	0.4354	
Total Assets/Equity	-0.0001 ***	-9.78	-0.0255	
Net Loans/Total Assets	-0.0044	-1.05	-0.0890	
Dep.&Funding/Total	-0.0003	-0.38	-0.0746	
Other Op. Income/Avg	-0.1270 ***	-3.38	-0.5768	
Country Rating	0.5039 ***	19.50	2.0869	
Multiple rating dummy	-0.2149	-1.31		-0.2356
Year Indicators				
2000	-0.3312 *	-1.70		-0.3632
2001	-0.4041 *	-1.86		-0.4432
2002	-0.6615 ***	-2.82		-0.7255
2003	-0.9278 ***	-3.76		-1.0176
2004	-0.8977 ***	-3.59		-0.9846
2005	-0.7463 ***	-2.95		-0.8185
2006	-0.5882 **	-2.29		-0.6451
2007	-0.3868	-1.47		-0.4242
2008	-0.4600 *	-1.73		-0.5045
2009	-0.6652 **	-2.50		-0.7295
2010	-0.7794 ***	-2.97		-0.8547
2011	-0.8353 ***	-3.16		-0.9161
2012	-0.9253 ***	-3.46		-1.0148
2013	-1.0171 ***	-3.79		-1.1154
2014	-0.9883 ***	-3.70		-1.0839
2015	-0.9812 ***	-3.67		-1.0761
No. of	26,086			
Pseudo R^2	0.1585			
Clusters of Banks	669			

'behaviour' of CRAs s. In order to infer such possible changes, in each table we present in the last two columns two products that will help assess the magnitude of the coefficient values, thus inferring whether such changes occurred. Column three presents for the non-dummy variables the product of its estimated coefficient and the variable's standard deviation[14], divided by the average distance between the rating categories, i.e. the average notch length. The product of the coefficient and the standard deviation measures the change in the conditional expectation in

[14] Standard deviations of variables in each table differ, as they are calculated for each CRA subsample, i.e. standard deviation of Log of Assets for the Fitch full sample is different from the standard deviation of Log of Assets for the Moody's full sample.

the latent variable given one standard deviation increase in the explanatory variable.

The denominator, i.e. the average distance between the rating categories is calculated by finding the average distance between cut points[15] (i.e. the average rating notch length is calculated as $(\mu_{16}-\mu_1)/15$, where μ_{16} is the last cut point, μ_1 is the first cut point and number 15 is the number of the in-between categories). Column four presents a similar transformation for the dummy variables to units of rating notches. This is done by calculating dummy coefficients as multiples of the average distance between the rating categories, or as explained previously, the average distance between cut points.

The values of column (3) in all tables provide for some interesting results. The most important contributing financial characteristics in determining bank credit ratings for Fitch full world sample are: Log of Assets, R.O.A.A. and Net Loans/Total Assets, for Moody's: Total Assets/Equity, Log of Assets and R.O.A.A., and finally S&P: Other Op. Income/Avg Assets, Log of Assets and R.O.A.A.

So, for example, an increase/decrease of one standard deviation in log of assets coefficient on average increases/decreases a bank's rating from Fitch by 0.73 notches, from Moody's by 0.79 notches and from S&P by 0.48 notches.

Furthermore, multiple ratings dummy, as mentioned above, has a significant value only for the Fitch suggesting that in the presence of another CRAs credit rating, a bank's Fitch rating increases by 0.37 notches.

Country Rating appear to be another a key contributor in determining bank credit ratings for all three CRAs. An increase/decrease of one standard deviation in the country's rating will on average increase/decrease a bank's rating from Fitch by 1.87 notches, from Moody's by 2.24 notches and from S&P by 2.09 notches.

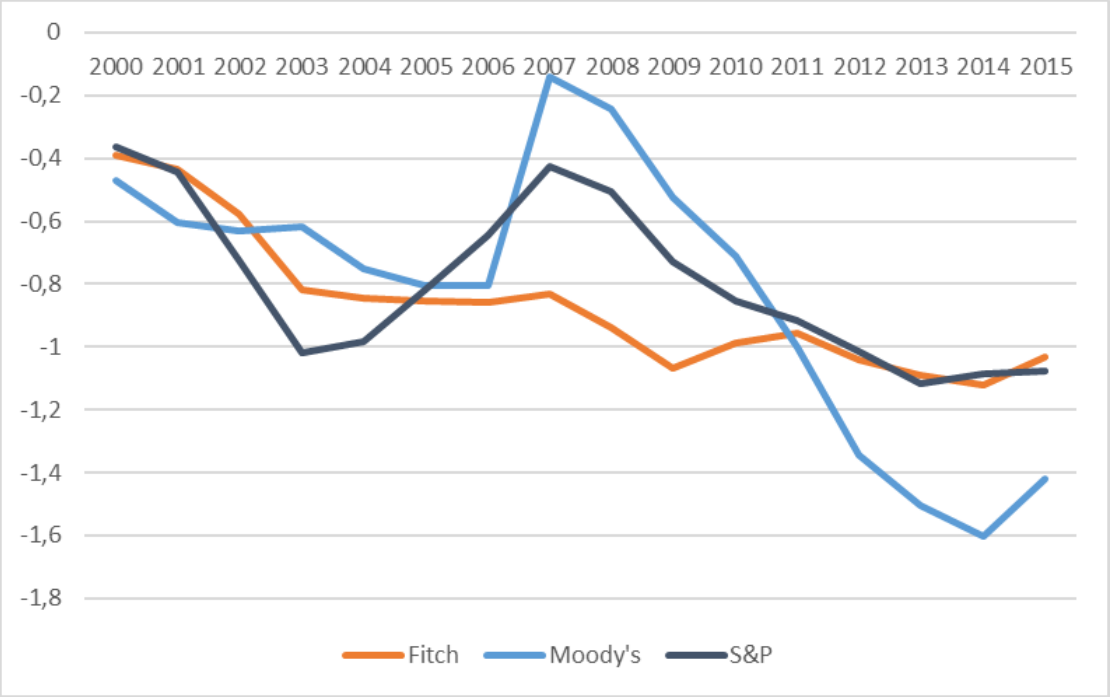
The main interest of the magnitude that explanatory variables affect credit ratings is on the year indicator variables, which -as already mentioned- are the epicentre of this study. The negative signs and coefficient values of all the year indicator coefficients for all three CRAs do not give us a clear picture of any trends and possible breaks in the period of our analysis. To assess the existence of a trend we concentrate on the transformation of year indicator coefficients to units of rating notches as explained above. The results are presented on column (4) in

[15] In an ordered logit model, the distance between cut points are not equal.

all tables. Figure 4.1 plots column 4 in Tables 4.5a, 4.5b and 4.5c that respectively correspond to the full world sample regression of Fitch, Moody's and S&P.

Figure 4.1

Plot of year indicator estimates for the full world sample, 2000 to 2015, for each CRA



All three plots in Figure 4.1 show a pattern towards stringency from 2000 to 2015, but with discrepancies that vary among the three CRAs. Fitch displays a downward trend or tightening of credit standards from 2000 to 2003, a trend to stabilize from it rating standards from 2003 to 2007, and then from 2007 to 2015 Fitch displays a generally stable pattern after a steep decrease on 2007. Moody's displays a slightly downward trend from 2000 to 2005/6, an abrupt loosening of standards from 2006 to 2007, and then a stable downward trend that indicates stringency that stops at 2014. Lastly, S&P displays a downward trend or tightening of standards from 2000 to 2003, from 2003 to 2007 it displays an upward trend or loosening of standards, from 2007 to 2013 a downward trend and from 2013 to 2015 a stable pattern.

4.5.2. Results per world region

In this sub-section we estimate the same ordered logit model but this time for different world regions. The findings in related literature (Parker and Tarashev, 2011, Salvador, Fernández de Guevara and Pastor, 2018) indicate that the hardening of bank rating policies by the three principal CRAs as a result of the

global financial crisis was different depending on the country or geographical area. As discussed in Part 3, an explanation for the observed differences in rating standards could either be due to a different calibration or bias in the application of the bank rating methodologies as CRAs structure their research departments into a number of offices/areas around the world which are responsible for the research in their region of concern/monitoring . In this way, we split our full world sample into three geographical areas, Europe, US & Canada and Rest of the World (RoW). Tables 4.6, 4.7 and 4.8 show the estimation results for the three world regions.

The results from all subsamples regressions are very similar to the full world sample regressions. Specifically, coefficients of Log of Assets, R.O.A.A. and Country Rating are in most cases significant and positive as expected, with an exception for the R.O.A.A. coefficients for the RoW/Fitch and RoW/Moody's subsamples which although have the correct signs are not significant. For the rest of the financial characteristics the results are again similar to the full world sample regressions. Total Assets/Equity coefficient has negative sign in all cases as expected, although not significant for Europe/Moody's, US&Canada/Moody's and US&Canada/S&P subsamples. The Net Loans/Total Assets coefficient has a negative sign for most cases, while it is not significant for Europe/S&P, RoW/Fitch and RoW/S&P subsamples. Deposits&Short-term Funding/Total Assets coefficient has a negative sign for all three European subsamples, a positive sign for RoW/Moody's subsample, while it is not significant for all three US&Canada subsamples and for RoW/Fitch and RoW/S&P subsamples. Other operating income/Average Assets coefficient is not significant for all cases except for US&Canada/Moody's and US&Canada/S&P subsamples.

The rest of the explanatory variables from the subsamples regressions also bear similar results to that of the full world sample regressions. The Country Rating coefficient has a positive sign and is highly significant with an exception for the US&Canada/Fitch subsample, where it is not significant different from zero. Once again, this last finding for the country rating is indicative of the importance of the sovereign rating in determining a bank's credit rating.

Table 4.6: Estimation results for European subsample per CRA

Estimation results for the ordered logit model for the **European** subsample of commercial banks. The dependent variable is equivalently the Fitch long-term issuer default rating, the Moody's long-term Issuer rating (foreign) and the S&P foreign currency long-term rating, all converted into an ordinal scale ranging from 1 to 17, whereas CCC+/Caa1 or worse corresponds to 1 and AAA/Aaa corresponds to 17. The explanatory variables are defined in the previous section. Standard errors are calculated using cluster-correlated robust estimate of variance at the bank level, and the asterisks *, **, and *** next to the coefficients values respectively correspond to significance levels 10%, 5% and 1%.

	Fitch				Moody's				S&P			
Variable	**Coefficient**	**Z stat**	$\frac{\text{Coefficient} \times \text{SD}}{\text{Rating Notch Length}}$	$\frac{\text{Coefficient}}{\text{Rating Notch Length}}$	**Coefficient**	**Z stat**	$\frac{\text{Coefficient} \times \text{SD}}{\text{Rating Notch Length}}$	$\frac{\text{Coefficient}}{\text{Rating Notch Length}}$	**Coefficient**	**Z stat**	$\frac{\text{Coefficient} \times \text{SD}}{\text{Rating Notch Length}}$	$\frac{\text{Coefficient}}{\text{Rating Notch Length}}$
Log of Assets	1.1851***	8.31	0.7551		0.8504***	4.45	0.6416		0.4418***	2.89	0.3030	
R.O.A.A.	0.1132***	3.08	0.1321		0.2511***	4.36	0.4127		0.2620***	3.33	0.2748	
Total Assets/Equity	-0.0001***	-10.02	-0.0351		-0.0060	-1.26	-2.9006		-0.0001***	-10.14	-0.0514	
Net Loans/Total Assets	-0.0136***	-2.79	-0.2103		0.0131**	2.00	0.2651		0.0057	1.06	0.1075	
Dep. & Funding/Total Asset	-0.0031***	-3.02	-0.2527		-	-4.00	-0.1228		-0.0034***	-4.10	-0.3594	
Other Op. Income/Avg Asse	-0.0402	-0.86	-0.0697		-0.0333	-1.61	-0.0841		-0.0181	-0.62	-0.0915	
Country Rating	0.7156***	17.73	2.3005		0.6078***	15.29	2.4287		0.7706***	17.86	2.4470	
Multiple rating dummy	-0.1536	-0.83		-0.1317	0.3033	1.25		0.3379	-0.0941	-0.35		-0.0881
Year Indicators												
2000	0.0482	0.16		0.0414	-1.7229**	-2.15		-1.9202	-0.8954***	-3.48		-0.8389
2001	-0.0287	-0.12		-0.0246	-2.0530**	-2.40		-2.2881	-1.1376***	-3.82		-1.0658
2002	-0.1646	-0.75		-0.1412	-1.8999**	-2.09		-2.1174	-1.2287***	-3.80		-1.1511
2003	-0.6472***	-2.95		-0.5553	-1.7223*	-1.82		-1.9196	-1.6143***	-4.49		-1.5125
2004	-0.7548***	-3.55		-0.6475	-1.7729*	-1.83		-1.9759	-1.5905***	-4.35		-1.4902
2005	-0.7242***	-3.47		-0.6213	-1.8903*	-1.94		-2.1068	-1.5811***	-4.28		-1.4813
2006	-0.5762***	-3.00		-0.4944	-1.8951*	-1.92		-2.1121	-1.5379***	-4.08		-1.4408
2007	-0.5370***	-2.89		-0.4607	-1.1560	-1.16		-1.2884	-1.1583***	-2.88		-1.0852
2008	-0.8034***	-4.23		-0.6892	-1.2958	-1.29		-1.4442	-1.2484***	-3.10		-1.1696
2009	-1.0981***	-5.68		-0.9421	-1.6085	-1.61		-1.7928	-1.4986***	-3.79		-1.4040
2010	-0.9666***	-5.37		-0.8292	-1.9694**	-1.98		-2.1949	-1.5731***	-3.98		-1.4738
2011	-0.9293***	-5.04		-0.7972	-2.3061**	-2.31		-2.5702	-1.8817***	-4.66		-1.7630
2012	-0.9455***	-4.71		-0.8112	-	-2.85		-3.1690	-2.0863***	-5.00		-1.9547
2013	-0.9727***	-4.67		-0.8345	-	-3.09		-3.4419	-2.1585***	-5.21		-2.0223
2014	-1.0926***	-5.17		-0.9374	-	-3.30		-3.6796	-2.0209***	-4.95		-1.8934
2015	-0.9084***	-3.74		-0.7794	-	-2.95		-3.2844	-1.9397***	-4.71		-1.8173
No. of observations			12,176				9,231				11,187	
Pseudo R^2			.2484				.2103				.2201	

Clusters of Banks	353	306	277

Table 4.7: Estimation results for US & Canada subsample per CRA

Estimation results for the ordered logit model for the US & Canada subsample of commercial banks. The dependent variable is equivalently the Fitch long-term issuer default rating, the Moody's long-term Issuer rating (foreign) and the S&P foreign currency long-term rating, all converted into an ordinal scale ranging from 1 to 17, whereas CCC+/Caa1 or worse corresponds to 1 and AAA/Aaa corresponds to 17. The explanatory variables are defined in the previous section. Standard errors are calculated using cluster-correlated robust estimate of variance at the bank level, and the asterisks *, **, and *** next to the coefficients values respectively correspond to significance levels 10%, 5% and 1%.

	Fitch				Moody's				S&P			
Variable	**Coefficient**	**Z stat**	$\frac{\text{Coefficient} \times \text{SD}}{\text{Rating Notch Length}}$	$\frac{\text{Coefficient}}{\text{Rating Notch Length}}$	**Coefficient**	**Z stat**	$\frac{\text{Coefficient} \times \text{SD}}{\text{Rating Notch Length}}$	$\frac{\text{Coefficient}}{\text{Rating Notch Length}}$	**Coefficient**	**Z stat**	$\frac{\text{Coefficient} \times \text{SD}}{\text{Rating Notch Length}}$	$\frac{\text{Coefficient}}{\text{Rating Notch Length}}$
Log of Assets	1.7896***	5.93	1.4959		1.3758***	6.34	1.4712		1.2879***	4.84	1.0638	
R.O.A.A.	0.2502***	3.63	0.6035		0.1455***	3.39	0.4659		0.3255***	5.72	0.8041	
Total Assets/Equity	-0.0032*	-1.67	-0.0797		0.0159	0.33	0.3579		-0.0016	-0.78	-0.0279	
Net Loans/Total Assets	-0.0213**	-2.13	-0.4680		-0.0167**	-2.12	-0.4881		-0.0318***	-3.19	-0.7781	
Dep. & Funding/Total Asset	-0.0015	-1.52	-0.3283		0.0000	0.04	0.0035		0.0000	0.11	0.0092	
Other Op. Income/Avg Asse	-0.0534	-0.70	-0.1898		-0.1188***	-2.58	-0.6660		-0.1394***	-2.81	-0.6530	
Country Rating	-0.6541*	-1.92	-0.0889		(omitted)				0.5170**	2.14	0.2551	
Multiple rating dummy	1.0936***	3.14		1.3618	-0.46973*	-1.68		-0.7732	0.1343	0.54		0.1756
Year Indicators												
2000					-0.2064	-1.27		-0.3397	-0.3681**	-2.10		-0.4814
2001	-0.0081	-0.13		-0.0101	-0.2748	-1.23		-0.4523	-0.4907**	-2.38		-0.6418
2002	-0.2753***	-2.70		-0.3428	-0.4471*	-1.81		-0.7360	-0.8794***	-3.91		-1.1502
2003	-0.4076***	-3.37		-0.5076	-0.6524**	-2.48		-1.0738	-1.0477***	-4.45		-1.3702
2004	-0.4773***	-3.77		-0.5943	-0.8386***	-3.42		-1.3804	-1.0283***	-4.16		-1.3449
2005	-0.4956***	-3.47		-0.6171	-0.8223***	-3.29		-1.3535	-0.9386***	-3.71		-1.2276
2006	-0.6127***	-3.88		-0.7629	-0.8537***	-3.26		-1.4051	-0.7498***	-2.81		-0.9807
2007	-0.6511***	-3.53		-0.8108	-0.4160	-1.45		-0.6848	-0.7548***	-2.82		-0.9872
2008	-0.7159***	-3.27		-0.8914	-0.6590**	-2.26		-1.0847	-0.7707***	-2.67		-1.0080
2009	-1.0189***	-3.53		-1.2687	-1.2974***	-3.20		-2.1354	-1.4889***	-4.53		-1.9473
2010	-1.5154***	-5.06		-1.8870	-1.8034***	-4.26		-2.9683	-2.0424***	-6.22		-2.6712
2011	-1.7220***	-5.58		-2.1442	-1.9476***	-4.66		-3.2057	-1.9170***	-5.85		-2.5071
2012	-1.9904***	-6.41		-2.4784	-2.3710***	-5.57		-3.9026	-1.7937***	-5.13		-2.3458
2013	-2.0418***	-6.83		-2.5424	-2.3151***	-6.00		-3.8106	-1.8757***	-5.54		-2.4531
2014	-1.9768***	-7.33		-2.4615	-2.4350***	-6.37		-4.0080	-1.9048***	-5.78		-2.4912
2015	-2.0029***	-6.96		-2.4940	-2.3192***	-6.12		-3.8173	-1.8992***	-5.69		-2.4838
No. of observations	6,225				6,274				6,960			

Pseudo R^2	.135	.0701	.0842
Clusters of Banks	162	185	174

Table 4.8: Estimation results for RoW subsample per CRA

Estimation results for the ordered logit model for the RoW subsample of commercial banks. The dependent variable is equivalently the Fitch long-term issuer default rating, the Moody's long-term Issuer rating (foreign) and the S&P foreign currency long-term rating, all converted into an ordinal scale ranging from 1 to 17, whereas CCC+/Caa1 or worse corresponds to 1 and AAA/Aaa corresponds to 17. The explanatory variables are defined in the previous section. Standard errors are calculated using cluster-correlated robust estimate of variance at the bank level, and the asterisks *, **, and *** next to the coefficients values respectively correspond to significance levels 10%, 5% and 1%.

	Fitch				Moody's				S&P			
Variable	**Coefficient**	**Z stat**	$\frac{\text{Coefficient} \times \text{SD}}{\text{Rating Notch Length}}$	$\frac{\text{Coefficient}}{\text{Rating Notch Length}}$	**Coefficient**	**Z stat**	$\frac{\text{Coefficient} \times \text{SD}}{\text{Rating Notch Length}}$	$\frac{\text{Coefficient}}{\text{Rating Notch Length}}$	**Coefficient**	**Z stat**	$\frac{\text{Coefficient} \times \text{SD}}{\text{Rating Notch Length}}$	$\frac{\text{Coefficient}}{\text{Rating Notch Length}}$
Log of Assets	1.3080***	5.83	0.6400		1.4020***	5.61	0.6794		1.1541***	4.36	0.5487	
R.O.A.A.	0.1131	1.39	0.2299		0.1426	1.59	0.2725		0.2201*	1.77	0.4585	
Total Assets/Equity	-0.0914***	-2.86	-0.6014		-0.0487*	-1.78	-2.3800		-0.0236**	-2.21	-0.1651	
Net Loans/Total Assets	0.0115	1.19	0.1183		0.0220**	2.04	0.2479		-0.0021	-0.18	-0.0248	
Dep. & Funding/Total Asset	0.0013	0.26	0.0452		0.0006***	3.68	0.0815		0.0000	0.00	0.0000	
Other Op. Income/Avg Asse	0.0692	0.78	0.0704		-0.1898	-1.49	-0.2288		-0.0420	-0.43	-0.0670	
Country Rating	0.7301***	14.28	2.1684		0.8404***	12.24	2.6097		0.7929***	12.31	2.3845	
Multiple rating dummy	1.2272***	5.09		0.3828	-0.0215	-0.09		-0.0166	0.0137	0.05		0.0102
Year Indicators												
2000					-0.2069	-0.66		-0.1602	-1.0645*	-1.91		-0.7928
2001	-0.5170**	-2.35		-0.3828	-0.1872	-0.63		-0.1450	-1.3486***	-2.60		-1.0044
2002	-1.0382***	-3.41		-0.7686	-0.0775	-0.18		-0.0600	-1.8022***	-2.82		-1.3421
2003	-1.5625***	-4.70		-1.1568	-0.1763	-0.35		-0.1365	-2.2604***	-3.35		-1.6834
2004	-1.6750***	-4.63		-1.2401	-0.3568	-0.68		-0.2763	-2.4034***	-3.52		-1.7898
2005	-1.7490***	-4.96		-1.2949	-0.4125	-0.77		-0.3194	-1.8242***	-2.59		-1.3585
2006	-1.9110***	-5.43		-1.4148	-0.4729	-0.87		-0.3662	-1.5404**	-2.14		-1.1471
2007	-1.8163***	-5.11		-1.3447	-0.0931	-0.16		-0.0721	-1.4886**	-2.08		-1.1086
2008	-1.7765***	-5.00		-1.3153	-0.0839	-0.15		-0.0650	-1.6154**	-2.24		-1.2030
2009	-1.6614***	-4.71		-1.2301	-0.0570	-0.10		-0.0441	-1.5183**	-2.12		-1.1307
2010	-1.7082***	-4.59		-1.2647	0.0652	0.12		0.0505	-1.7340**	-2.44		-1.2913
2011	-1.8384***	-4.80		-1.3610	-0.1739	-0.31		-0.1346	-1.6213**	-2.24		-1.2074
2012	-1.9559***	-4.79		-1.4481	-0.1711	-0.30		-0.1325	-1.5709**	-2.13		-1.1698
2013	-2.1581***	-5.30		-1.5977	-0.3193	-0.57		-0.2473	-1.7248**	-2.35		-1.2844
2014	-2.1769***	-5.13		-1.6117	-0.4023	-0.71		-0.3116	-1.7851**	-2.44		-1.3294
2015	-2.1523***	-4.97		-1.5935	-0.4393	-0.76		-0.3402	-1.8547**	-2.53		-1.3812

No. of observations	8,146	6,793	7,939
Pseudo R^2	0.2916	0.317	0.2909
Clusters of Banks	262	255	218

Multiple rating dummy coefficient has a positive sign and high significance only for the US&Canada/Fitch and RoW/Fitch subsamples (also 10% significance level for US&Canada/Moody's but with a negative sign), which is very much in accordance with the findings from the full world sample regressions, i.e. that Fitch gives higher credit ratings when at least one of the other two CRAs have also rated a particular bank at the same quarter, an inference which does not hold for the other two CRAs.

In the same manner as before, in order to assign economic significance in each table, columns 3 and 4 assess the magnitude of the coefficient values. Column 3 presents the average notch length for the non-dummy variables and column 4 presents a similar transformation of units of rating notches for the dummy variables.

In all instances, Log of Assets is the most contributing to what financial characteristic, except for Europe/S&P subsample where Dep. & Funding/Total Assets is the most contributing financial characteristics and Log of Assets is the second most contributing financial characteristics. The rest of the financial characteristics appear as second, third, etc most contributing financial characteristics but without any clear lead for any them for any CRA or world region.

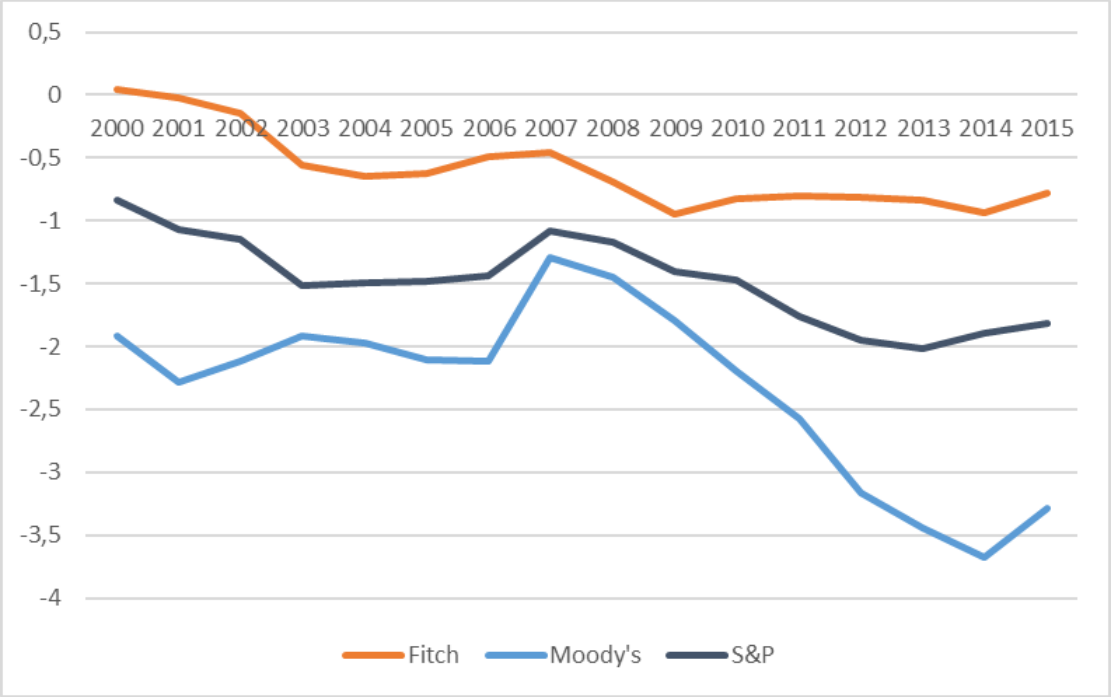
In the above manner, an increase/decrease of one standard deviation in log of assets on average increases/decreases a bank's rating in the Europe/Fitch subsample by 0.76 notches, in the Europe/Moody's subsample by 0.64 notches, in the Europe/S&P subsample by 0.30 notches, in the US&Canada/Fitch subsample by 1.50 notches, in the US&Canada/Moody's subsample by 1.47 notches, in the US&Canada/S&P subsample by 1.06 notches, in the RoW/Fitch subsample by 0.64 notches, in the RoW/Moody's subsample by 0.68 notches and in the RoW/S&P subsample by 0.55 notches.

Furthermore, for the multiple rating dummy, for which we observe significant values only for the US&Canada/Fitch and RoW/Fitch subsamples, a bank's Fitch rating increases by 1.36 and 0.38 notches respectively in the presence of competition. Country Rating appear to be a key contributor in determining bank credit ratings for all three CRAs, but not for the US&Canada subsamples. An increase/decrease of one standard deviation in the country rating on average increases/decreases a bank's rating in the Europe/Fitch subsample by 2.30 notches, in the Europe/Moody's subsample by 2.43 notches, in the

Europe/S&P subsample by 2.45 notches, in the RoW/Fitch subsample by 2.17 notches, in the RoW/Moody's subsample by 2.61 notches and in the RoW/S&P subsample by 2.68 notches.

Lastly, we focus on the year indicator variables to identify the time-series variation in bank credit rating standards in the same manner as for the full world sample. Again, the negative signs and coefficient values of all all year indicator coefficients for all World region/CRA subsamples do not provide for a clear picture to assess the existence of a trend and the economic significance we concentrate on the transformation of year indicator coefficients to units of rating notches, which are found on column four in all three tables. Figures 4.2, 4.3 and 4.4. plot column 4 of each CRA respectively from Tables 4.6, 4.7 and 4.8 that correspond to each of the world subsamples, i.e. the European, US&Cananda and RoW subsamples.

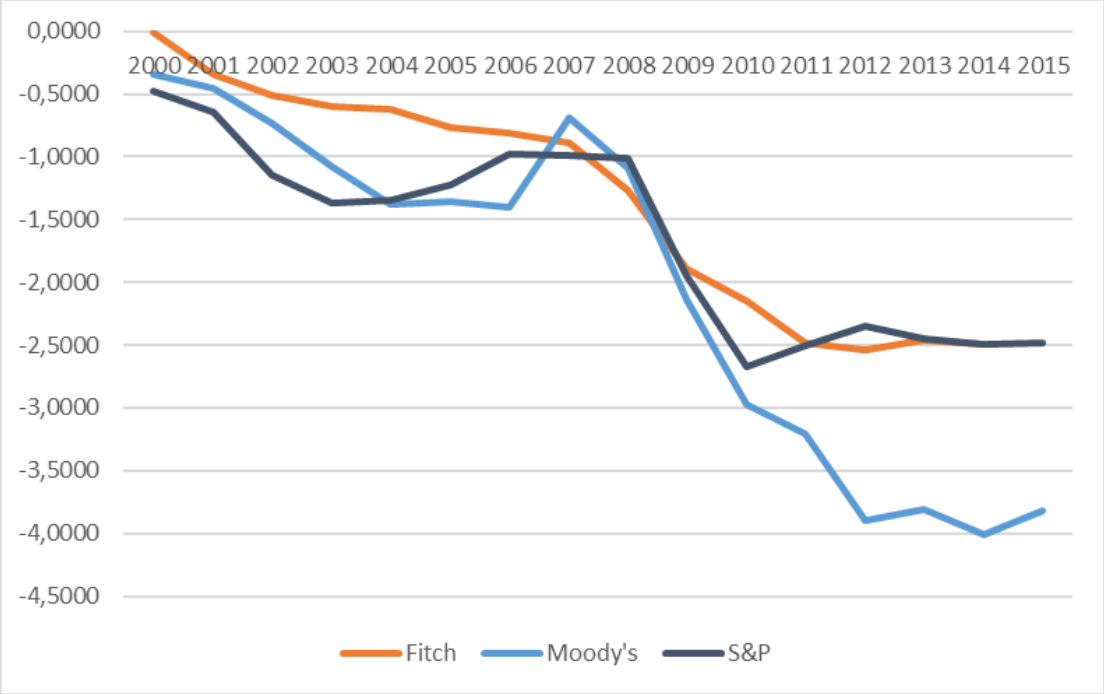
Figure 4.2 Plot of year indicator estimates for the European subsample, from 2000 to 2015, for each CRA



For the European subsample in Figure 4.2, we observe differentiated patterns of the three plots that correspond to the time trends from 2000 to 2015 of Fitch, Moody's and S&P. Fitch displays a slightly downward pattern for the whole period. From 2000 to 2003 we observe a downward trend of approximately 0.5 notch, then from 2003 to 2007 we observe a rather stable pattern with minor discrepancies, from 2007 to 2009 we observe a rather abrupt tightening of standards by 0.5 notch and then from 2009 to 2015 we observe a stable pattern with minor discrepancies. On the other hand, Moody's displays a rather stable

pattern with minor discrepancies from 2000 to 2006, from 2006 to 2007 we observe a rather abrupt loosening of standards by almost 1.0 notch, and then from 2007 to 2015 we observe a stable downward trend that indicates stringency that stops at 2014. Lastly, S&P displays a downward trend of approximately 0.5 notch from 2000 to 2003, from 2003 to 2006 it displays stable standards, from 2006 to 2007 a loosening of almost 0.5 notch, from 2007 to 2013 a downward trend and from 2013 to 2015 a stable pattern.

Figure 4.3 Plot of year indicator estimates for the US & Canada subsample, from 2000 to 2015, for each CRA



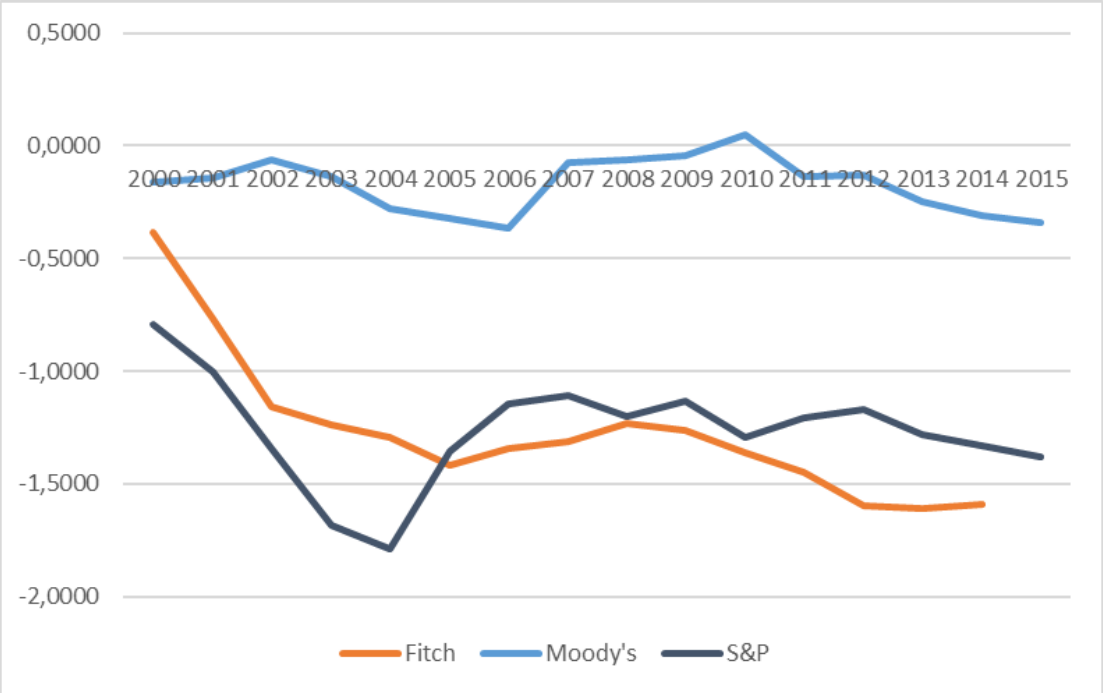
For the US & Canada subsample in Figure 4.3, we observe patterns of the three plots that again with similarities to the corresponding European patterns, but up until year 2008. Fitch displays a downward pattern for the whole period. From 2000 to 2007 we observe a downward trend of approximately 1.0 notch, then from 2007 to 2011 we observe an abrupt downward slope which translates into a sudden tightening of credit standards, and from 2011 to 2015 we observe a rather stable pattern. Moody's displays a downward trend of approximately 1.0 notch from 2000 to 2004, from 2004 to 2006 a stable pattern, from 2006 to 2007 a rather abrupt loosening of standards by almost 1.0 notch, and similar to Fitch, from 2007 to 2012 we observe an abrupt downward slope which translates into a sudden tightening of credit standards, and from 2012 to 2015 we observe a rather stable pattern. Lastly, S&P displays a downward trend of approximately 1.0 notch from 2000 to 2003, from 2003 to 2006 it displays upward slope or loosening of

standards of approximate 0.5 notch, from 2006 to 2008 it displays stable standards, from 2008 to 2010 we observe an abrupt downward slope which translates into a sudden tightening of credit standards, and from 2010 to 2015 we observe a rather stable pattern.

For the RoW subsample in Figure 4.4, we are distinguishing similar patterns for only of the two out of the three plots, i.e. for Fitch and S&P. Moody's displays a rather stable pattern throughout the whole period, with minor discrepancies of no more than 0.5 notch in total. On the other hand, Fitch displays a downward pattern from 2000 to 2005, from 2005 to 2008 a slightly upward pattern and from 2008 to 2014 a slightly downward pattern. Lastly, S&P displays a downward trend of more than 1.0 notch from 2000 to 2004, from 2004 to 2007 it displays upward slope or loosening of standards of approximately 0.5 notch, and from 2007 to 2015 it displays a rather stable pattern.

Figure 4.4

Plot of year indicator estimates for the RoW sample, 2000 to 2015, for each CRA



4.5.3. Structural Break Tests

All figures of the year indicator estimates, despite their apparent differences, they all share major similarities. We observe a movement toward more stringent standards from 2002 to 2005, then the loosening of standards until 2008, and finally the abrupt tightening of standards from 2009. This is similar to

what we shown in Figure 3.1, where for the mean values of bank credit ratings from 2000 to 2015 of each of the three principal CRAs we observed a U-curve shape from 2000 to 2007, and then a worsening of bank credit ratings during the period 2008-9 and then further decline during the period 2010-12. So, all figures imply the existence of at least three structural breaks in the year indicators. To test for such breaks in the movements observed in all figures we proceed with structural break tests to examine a possible change in the level and slope of the year indicators.

4.5.3.1. Structural Break Tests for the full world sample

In order to verify this overall pattern of the three structural breaks that we distinguish, we proceed with structural break tests for both the level and slope of the year indicators as in Alp (2013). The ordered logit model of equations (1) to (2) is modified so that year indicators are removed from the vector of the explanatory variables X_{it} and three dummy variables D_1, D_2, and D_3, are added, to test for the three structural breaks that create four time periods. In this way equation (2) becomes:

$$Z_{it} = b_1 D_1 + b_2 D_2 + b_3 D_3 + \beta' X_{it} + \varepsilon_{it} \qquad (3)$$

Dummy variable D_1 takes the value 1 for the years 2002 to 2005, dummy variable D_2 takes the value 1 for the years 2006 to 2008, and dummy variable D_3 takes the value 1 for the years 2009 to 2015, while coefficients b_1, b_2 and b_3 correspond to the three dummy variables that measure the intercepts of the different time periods.

In Table 4.9 (a) the values of the three coefficients of equation (3) are reported for the same models as in Tables 4.5a, 4.5b and 4.5c, i.e. for the world sample of bank ratings by each of the three principal CRAs. Next to each coefficient, the coefficient estimate in units of rating step length as previously is also reported, while in the last column the *p*-value for the Wald χ^2 test for the hypothesis that all coefficients are equal to zero is reported. The results of the Wald test reject the null of zero coefficients for all three models of the principal CRAs, which means that the intercepts for each time period is different, likewise for all three models of the principal CRAs.

In the same fashion, in order to test the slopes of the year indicators for all four time periods distinguished by the three structural breaks, we re-write equation (2) as:

Table 4.9: Estimation results for Structural Breaks for the World sample

a. World sample: Wald test for intercepts

Estimation results for the ordered logit model for the full world sample of commercial banks. In each row we estimate the same model as in Tables 4.5a, 4.5b and 4.5c, equivalently, replacing year indicators with the three dummy variables D_1, D_2, and D_3 to test for the three structural breaks defined above. All coefficients b_1, b_2 and b_3 are found to be significant at 1%, while next to each coefficient we report next to each coefficient the coefficient estimates in units of rating step length as defined above. In the last column we report the *p*-value for the Wald χ^2 test for the hypothesis that all coefficients are equal to zero.

	b_1 2002-5	Coefficient/ Rating Notch Length	b_2 2006-8	Coefficient/ Rating Notch Length	b_3 2009-15	Coefficient/ Rating Notch Length	*p-value*
Fitch	-0.388	-0.365	-0.486	-0.458	-0.662	-0.623	0.000
Moody'	-0.354	-0.419	-0.072	-0.085	-0.733	-0.868	0.000
S&P	-0.633	-0.696	-0.290	-0.319	-0.697	-0.766	0.000

b. World sample: Wald test for slopes

Estimation results for the ordered logit model for the full world sample of commercial banks. In each row we estimate the same model as in Tables 4.5a, 4.5b and 4.5c, equivalently, replacing year indicators with the four dummy variables D_0, D_1, D_2, and D_3 to test for the slope of the year indicators of the four time periods. Not all coefficients b_{02}, b_{12}, b_{22} and b_{32} are found to be significant at 10%, 5% or 1%. In the last column we report the *p*-value for the Wald χ^2 test for the hypothesis that all coefficients are equal.

	b_{02} -2001	b_{12} 2002-5	b_{22} 2006-8	b_{32} 2009-15	*p-value*
Fitch	-0.022	-0.022	-0.011	-0.003	0.030
Moody's	-0.062	-0.013	0.054	-0.036	0.000
S&P	-0.046	-0.001	0.013	-0.014	0.002

$$Z_{it} = b_{02}tD_0 + b_{11}D_1 + b_{12}tD_1 + b_{21}D_2 + b_{22}tD_2 + b_{31}D_3 + b_{32}tD_3 + \beta' X_{it} + \varepsilon_{it} \quad (4)$$

We add dummy D_0 which takes the value 1 for years until 2001 and a quarterly trend variable *t*, so that coefficient estimates b_{02}, b_{12}, b_{22} and b_{32} measure the rate that rating standards change or the slope of the year indicators of the four time periods.

In Table 4.9 (b) the values of the four coefficients of equation (4) are reported for the same models as in Tables 4.5a, 4.5b and 4.5c, i.e. for the world sample of bank ratings by each of the three principal CRAs, while in the last column the *p*-value for the Wald χ^2 test for the hypothesis that all coefficients are

equal is reported. The results of the Wald test reject the null of equal coefficients for all three models of the principal CRAs, but for Fitch only at the 3% level of significance.

In order to interpret the structural break results for the world sample, we need to examine them alongside with Figure 4.1. Even though we have distinguished three structural breaks in all figures, not all three CRAs follow the same pattern in Figure 4.1.

Moody's and Standard & Poor's seems to be more apparent for the loosening of rating standards in 2006-8, where Fitch is not. Intercept coefficients of Moody's and Standard & Poor's are significantly lower than the previous period's coefficients, but they are also lower than the following period's coefficients. Their slope coefficients during 2006-8 are positive which confirms a clear loosening of rating standards. This is not the case for Fitch, for which the intercept coefficient during 2006-8 is higher than the previous period while the slope coefficient remains negative. The last period of 2009-15 where rating standards seem to tighten, again bears differences among the three CRAs as in Figure 4.1. There seems to be a different degree of tightening of the rating standards with Moody's being more rigorous. The intercept coefficients for the period of 2009-15 of all three CRAs increase substantially, but the increase relative to the intercept coefficient of the previous period is greater for Moody's and Standard & Poor's. The slope coefficients for Moody's and Standard & Poor's turn negative from positive in the previous period of 2006-8, while for Fitch the slope coefficient sign remains negative but decreases.

Overall from the full world sample structural break results, for Fitch we can say that according to the structural break tests there seems to be neither a loosening of bank rating standards before the global financial crisis nor a hardening of standards as an aftermath of the crisis. What can be inferred for Fitch by the full world sample is that there has been a constant hardening of bank rating standards, or a conservatism, through the whole period of our study, which was intensified in the last period of 2009-15. On the other hand, Moody's and Standard & Poor's loosened their bank rating standards just until the global financial crisis and then hardened their rating standards, with Moody's being more rigorous. Moody's hardening of rating standards in 2009-15 is approximately 0.80 notch versus 2006-8, whereas Standard & Poor's is approximately 0.50 notch.

Table 4.10:

Estimation results for Structural Breaks for the European Subsample

a. European subsample: Wald test for intercepts

Estimation results for the ordered logit model for the European subsample of commercial banks. In each row we estimate the same model as in Table 4.2, replacing year indicators with the three dummy variables D_1, D_2, and D_3 to test for the three structural breaks defined above. All coefficients b_1, b_2 and b_3 by Fitch and Standard & Poor's are found to be significant at 1%, while next to each coefficient we report next to each coefficient the coefficient estimates in units of rating step length as defined above. In the last column we report the *p*-value for the Wald χ^2 test for the hypothesis that all coefficients are equal to zero.

	b_1 2002-5	Coefficient/ Rating Notch Length	b_2 2006-8	Coefficient/ Rating Notch Length	b_3 2009-15	Coefficient/ Rating Notch Length	*p-value*
Fitch	-0.574	-0.534	-0.625	-0.582	-0.976	-0.908	0.000
Mood	-0.630	-0.721	-0.258	-0.295	-1.346	-1.539	0.000
S&P	-0.993	-0.939	-0.765	-0.722	-1.316	-1.249	0.000

b. World sample: Wald test for slopes

Estimation results for the ordered logit model for the full world sample of commercial banks. In each row we estimate the same model as in Tables 4.5a, 4.5b and 4.5c, equivalently, replacing year indicators with the four dummy variables D_0, D_1, D_2, and D_3 to test for the slope of the year indicators of the four time periods. For the model of Fitch coefficients b_{12} and b_{22} are found to be significant (at 1%), for the model of Moody's coefficients b_{02}, b_{22} and b_{32} are found to be significant (at 1%), and for the model of Standard & Poor's all coefficients b_{02}, b_{12}, b_{22} and b_{32} are found to be significant (b_{12} at 10% and the rest at 1%). In the last column we report the *p*-value for the Wald χ^2 test for the hypothesis that all coefficients are equal.

	b_{02} -2001	b_{12} 2002-5	b_{22} 2006-8	b_{32} 2009-15	*p-value*
Fitch	-0.008	-0.041	-0.029	0.001	0.014
Moody's	-0.229	-0.004	0.065	-0.065	0.000
S&P	-0.127	-0.021	0.029	-0.023	0.000

4.5.3.2. Structural Break Tests per world region

Likewise, we proceed with structural break test for each of the three subsamples and the results are reported in Tables 4.6, 4.7 and 4.8. For the European subsample we again need to combine the results of Table 4.10 alongside with Figure 4.2. Same as above, we observe again not all three CRAs follow the same pattern that we have distinguished with the three structural breaks. For Fitch, both intercept and slope coefficients do not indicate the loosening of rating standards in 2006-8, whereas for Moody's and Standard &

Table 4.11

Estimation results for Structural Breaks for the US & Canada subsample

a. US & Canada subsample: Wald test for intercepts

Estimation results for the ordered logit model for the US & Canada subsample of commercial banks. In each row we estimate the same model as in Table 4.2, replacing year indicators with the three dummy variables D_1, D_2, and D_3 to test for the three structural breaks defined above. All coefficients b_1, b_2 and b_3 are found to be significant at 1%, while next to each coefficient we report next to each coefficient the coefficient estimates in units of rating step length as defined above. In the last column we report the *p*-value for the Wald χ^2 test for the hypothesis that all coefficients are equal to zero.

	b_1 2002-5	Coefficient/ Rating Notch Length	b_2 2006-8	Coefficient/ Rating Notch Length	b_3 2009-15	Coefficient/ Rating Notch Length	*p-value*
Fitch	-0.404	-0.510	-0.648	-0.817	-1.703	-2.148	0.000
Moody'	-0.549	-0.778	-0.517	-0.733	-1.927	-2.730	0.000
S&P	-0.792	-1.038	-0.573	-0.751	-1.629	-2.136	0.000

b. US & Canada subsample: Wald test for slopes

Estimation results for the ordered logit model for the US & Canada subsample of commercial banks. In each row we estimate the same model as in Tables 4.5a, 4.5b and 4.5c, equivalently, replacing year indicators with the four dummy variables D_0, D_1, D_2, and D_3 to test for the slope of the year indicators of the four time periods. For the model of Fitch coefficients b_{12} and b_{23} are found to be significant (at 1% and 5% respectively), for the model of Moody's coefficients b_{12} and b_{23} are found to be significant (both at 1%), and for the model of Standard & Poor's only coefficient b_{02} is found to be significant (at 5%). In the last column we report the *p*-value for the Wald χ^2 test for the hypothesis that all coefficients are equal.

	b_{02} -2001	b_{12} 2002-5	b_{22} 2006-8	b_{32} 2009-15	*p-value*
Fitch	-0.006	-0.018	-0.017	-0.038	0.372
Moody's	-0.034	-0.032	0.016	-0.042	0.142
S&P	-0.054	-0.003	-0.007	-0.011	0.254

Poor's their intercept and slope coefficients indicate the loosing and then the hardening of rating standards. Also, similarly as in the world sample, Moody's is more rigorous in the hardening, but Standard & Poor's is also rigorous. Moody's hardening of rating standards in 2009-15 is 1.24 notch versus 2006-8, whereas Standard & Poor's is 0.53 notch.

For the US & Canada subsample we once again combine the results of Table 4.11 alongside with Figure 4.3. Same as in the European subsample, Fitch's both intercept and slope coefficients do not indicate the loosening of rating

standards in 2006-8, but they indicate a hardening of rating standards in 2009-15. Again, Moody's and Standard & Poor's intercept and slope coefficients indicate the loosening of rating standards in 2006-8 and then the hardening of rating standards in 2009-15. Standard & Poor's loosening of rating standards in 2006-8 is less pronounced, whereas for both Moody's and Standard & Poor's the hardening in 2009-15 is more severe. Moody's hardening of rating standards in 2009-15 is 2 notches versus 2006-8, whereas Standard & Poor's is 1.39 notch.

Lastly, for the RoW subsample we observe the results of Table 4.12 alongside with Figure 4.4. Significance levels are very low for many of the coefficients, while the model of S&P does not converge. For Fitch, similarly as above, both intercept and slope coefficients do not indicate the loosening of rating standards in 2006-8, but what distinguishes to the other world regions is the abrupt hardening of rating standards in 2002-5 by almost one notch. For Moody's the results are ambiguous since on the one hand we have an inversion of the sign of the slope coefficients for the periods 2002-5 and 2006-8 (from negative to positive), but on the other hand Wald χ^2 test for the hypothesis that all intercept coefficients are equal to zero is not rejected.

Table 4.12

Estimation results for Structural Breaks for the RoW subsample

a. RoW subsample: Wald test for intercepts

Estimation results for the ordered logit model for the RoW subsample of commercial banks. In each row we estimate the same model as in Table 4.2, replacing year indicators with the three dummy variables D_1, D_2, and D_3 to test for the three structural breaks defined above. All coefficients b_1, b_2 and b_3 by Fitch are only found to be significant (at 1%), while next to each coefficient we report next to each coefficient the coefficient estimates in units of rating step length as defined above. In the last column we report the *p*-value for the Wald χ^2 test for the hypothesis that all coefficients are equal to zero.

	b_1 2002-5	Coefficient/ Rating Notch Length	b_2 2006-8	Coefficient/ Rating Notch Length	b_3 2009-15	Coefficient/ Rating Notch Length	*p-value*
Fitch	-1.095	-0.950	-1.371	-1.189	-1.467	-1.270	0.000
Moody'	-0.188	-0.146	-0.069	-0.054	-0.089	-0.069	0.821
S&P	-1.278	-1.025	-0.740	-0.593	-0.880	-0.705	0.000

b. RoW subsample: Wald test for slopes

Estimation results for the ordered logit model for the RoW subsample of commercial banks. In each row we estimate the same model as in Tables 4.5a, 4.5b and 4.5c, equivalently, replacing year indicators with the four dummy variables D_0, D_1, D_2, and D_3 to test for the slope of the year indicators of the four time periods. For the model of Fitch coefficients b_{10} , b_{11} and b_{13} are found to be significant (all at 1%), and for the model of Moody's coefficients b_{12} and b_{13} are found to be significant (at 5% and 1% respectively). The model of S&P does not converge. In the last column we report the *p*-value for the Wald χ^2 test for the hypothesis that all coefficients are equal.

	b_{02} -2001	b_{12} 2002-5	b_{22} 2006-8	b_{32} 2009-15	*p-value*
Fitch	-0.165	-0.053	0.018	-0.024	0.000
Moody's	-0.034	-0.027	0.048	-0.021	0.018
S&P	n/a	n/a	n/a	n/a	n/a

4.6. Robustness Tests

In this section we proceed with a variety of alternative specifications of the above models to check for the robustness of our results. Blume, Lime, and MacKinlay (1998) indicate two main criticisms that can challenge the validity of their results: first the assumption that the slope coefficients of their model are constant over time and second the likelihood of omitting important explanatory variables. The first criticism is also noted by Alp (2013) as an underlying assumption for the year indicator approach. I.e. if slope coefficients change over time then year indicators

are misleading as a measure of change in rating standards. The second criticism above is also addressed by Alp (2013), as in most of the related literature (Baghai, Servaes, and Tamayo, 2014, Salvador, Fernández de Guevara and Pastor, 2018). In the following two subsections we first proceed with robustness tests for alternative or additional variables and then we examine for the robustness of our year indicator approach. For the sake of brevity, given the extent of all the tests below findings are not presented.

4.6.1. Robustness to Additional Explanatory Variables

Omitting important explanatory variables could challenge the validity of our results, since an omitted variable or variables could be behind the explanatory power of the year effects, i.e. year effects may be capturing the time trend of an omitted variable or variables. Hence, we proceed by using a number of alternative or additional explanatory financial variables and specifications. However, it should be noted that for some of the alternative explanatory variables used in the robustness tests below there is limited number of observations, this is due to the fact that for most banks there is limited financial data before 2005 or 2000.

Accordingly, we proceed with alternative specifications using appropriate different explanatory financial variables for the key financial characteristics that we defined in subsection 4.3.3.1. First, for profitability, as an alternative to ROAA we use: a. Return on Average Equity (ROAE), b. Net Interest Margin and c. Net Interest Revenue divided by Average Assets. Second, for leverage, as an alternative to Total Assets divided by Equity we use: a. Tier 1 Ratio[16], b. Total Capital Ratio[17] and c. Equity divided by Net Loans. Third for asset structure and funding structure, as alternative to Net Loans divided by Total Assets, Net profits on trading and derivatives divided by Total Assets, and Short-term Funding divided by Total Assets, we use: a. Total Loans divided by Customer Deposits, b. Interbank Assets divided by Interbank Liabilities and c. Customer Deposits divided by Total Funding excluding Derivatives. All the above alternative variables give similar results, i.e. the figures of the year indicator estimates change very slightly.

Furthermore, we proceed with the use of additional explanatory financial variables. Initially we use Growth of Total Assets and Growth of Gross Loans, but both bear no significance for all three CRAs. Next we use a number of different

[16] Tier 1 capital divided by total risk weighted assets.
[17] Total capital divided by total risk weighted assets.

variables that cover asset quality or risk factor, which was introduced in the revised standalone methodologies of both Fitch and Moody's after 2011. The variables we use are: a. Loan Loss Reserves divided by Impaired Loans, b. Impaired Loans (NPLs) divided by Gross Loans, c. Impaired Loans divided by Equity, and d. Loan Loss Reserves divided by Gross Loans. Even though some of the above are significant in the re-specified regressions, again the figures of the year indicator estimates change very slightly.

Finally bank size, which as explained previously is an important factor for bank ratings because it is related to the likelihood of external support from authorities, is difficult to proxy in order to check for its robustness. Salvador, Fernández de Guevara and Pastor (2018) use government support indicator for a robustness check for bank size. This indicator is directly provided by Fitch for the period of the authors' analysis, and for Moody's the indicator is constructed as the difference between the issuer rating and the Baseline Credit Assessment (BCA). For Standard & Poor's the authors cannot construct this indicator, so they do not perform a robustness check. In our case it is not possible to do the same as in Salvador, Fernández de Guevara and Pastor (2018), since our sample starts many years before the revised standalone indicators of Fitch and Moody's were introduced, while we would not be able to check for Standard & Poor's. Alternatively, we proceed with a robustness check for bank size, by calculating bank size divided by GDP of the country the bank is based or mainly operates. Again, all the regressions give similar results, i.e. the figures of the year indicator estimates barely change.

4.6.2. Robustness to Year Indicator Approach

As noted above, constant slope coefficients over time is the underlying assumption behind the year indicator approach. If slope coefficients are not constant and change over time, then the calculated year indicators are misleading, and thus the conclusions for our structural shifts for the rating standards are unreliable

In order to test for constant slope coefficients, we include the square and cube terms of all financial explanatory variables in order to allow for nonlinearities. The increase in all models' explanatory power compared to the base models is minor, and the figures of the year indicator estimates do really alter. For the increase in the explanatory power, it is indicative to say that the *adjusted* R^2 of the

Fitch base model of the world sample increase only by 0.014 when the square and cube terms of all financial explanatory variables are added.

4.7. Conclusion

This essay analyses the time-series variation in bank credit rating standards 2000 to 2015 by the three principal CRAs. We investigate whether the criticism of relaxed and subsequent tightened credit rating standards during the period of our analysis is empirically supported for banks. Overall we distinguish three structural breaks in the bank credit rating standards dividing the time -span of our analysis to the following periods compared to the initial period before the 2001-2 high profile corporate collapses, as follows, a) the period after the 2001-2 high profile corporate collapses when credit rating standards tightened, b) the period before the global financial crisis started when bank credit rating standards loosened, and c) the period after the global financial crisis when bank credit rating standards tightened.

Each of the three principal CRAs displays a different evolution of ratings in each of the three sub-periods. Fitch has followed a constant tightening of bank rating standards throughout, while this 'trend' was intensified after the global financial crisis. This pattern for Fitch is more intense in the European and US&Canada subsamples, i.e. Fitch followed a continued tightening of bank rating standards for European, US and Canadian banks in the period after the global financial crisis. E.g. credit ratings by Fitch for European banks tightened by 0.33 notch after the global financial crisis, by 1.33 notches for US and Canadian banks, and by 0.08 notches for RoW banks.

In comparison Moody's has started with a tightening of bank rating standards in the post Dot-com crash period, followed by a loosening of bank rating standards in the pre-global financial crisis period, and a tightening of bank rating standards in the post global financial crisis period. The loosening of bank rating standards in the pre global financial crisis period is more evident for European banks, compared to the US and Canadian banks. E.g. credit ratings by Moody's for European banks loosened by 0.43 notch before the global financial crisis, and only by 0.05 notch for US and Canadian banks, and by 0.09 notch for RoW banks. The hardening of bank rating standards in the post global financial crisis period is more intense for European, US and Canadian banks, while not evident for the RoW banks. E.g. credit ratings by Moody's for European banks tightened by 1.24

notches after the global financial crisis, by 2.00 notches for US and Canadian banks, and by 0.09 notch for RoW banks.

Standard & Poor's, similar to Moody's, has followed a tightening of bank rating standards in the post Dot-com crash period, then a loosening of bank rating standards in the pre global financial crisis period, and a loosening of bank rating standards in the post global financial crisis period. The loosening of bank rating standards in the pre global financial crisis period is almost the same for all geographical regions. E.g. credit ratings by Standard & Poor's for European banks loosened by 0.22 notch before the global financial crisis, by 0.29 notch for US and Canadian banks, and by 0.43 notch for RoW banks. The hardening of bank rating standards in the post global financial crisis period is very intense for the US and Canadian banks, while much less intense for European, US and Canadian banks. E.g. credit ratings by Standard & Poor's for European banks tightened by 0.53 notch after the global financial crisis, by 1.39 notches for US and Canadian banks, and by 0.11 notch for RoW banks.

Overall we can say that for the period of our study, Moody's and Standard & Poor's were rather more aligned in their structural shifts of bank credit rating standards, and all three principal CRAs were unanimous in the hardening of bank credit rating standards for US and Canadian banks in the post global financial crisis period. A possible explanation of our findings is that Fitch, as the last entrant to the credit rating industry, seems to have followed a more conservative policy before the global financial crisis compared to the other two agencies which dominated the market of credit ratings. In the presence of competition, Fitch gives higher credit ratings for US, Canadian and RoW banks. The unanimous hardening of bank credit rating standards for US and Canadian banks by all three principal CRAs can be attributed to the more severe effects that the collapse of the subprime mortgage market had on the balance sheets of the US banks.

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Stickiness in Bank Credit Ratings

ABSTRACT

This essay proposes a model to investigate the existence of stickiness in bank ratings by the three principal CRAs for a worldwide sample from 1988 to 2015. We consider stickiness as the factor that affects credit quality, and indirectly impacts rating accuracy and stability, up to 12 months before a bank's credit rating is either upgraded or downgraded. We find that bank ratings by all three CRAs are sticky and that there exists an asymmetry for upgrades and downgrades. The average notch effect of upgrade stickiness is close to one for all three CRAs, while S&P has the highest average notch effect of downgrade stickiness of 0.17, Moody's has almost zero and Fitch surprisingly has negative downgrade stickiness that we name as downgrade conservatism. When examining high versus low credit quality bank ratings, we that find Fitch and Moody's have higher upgrade stickiness for their investment-grade subsamples compared to their speculative-grade subsamples, whereas the opposite is true for S&P. Moody's and S&P have small downgrade stickiness for their investment-grade subsamples, while downgrade conservatism is only found in all three CRAs' speculative-grade subsamples, but also in Fitch's investment-grade subsample. Our findings are concluded with chronological structural breaks in stickiness practices by the three principal CRAs as we observe a decrease of stickiness in the periods that follow the 2001-2 high profile corporate collapses and an increase in the effect of stickiness in the periods that follow the 2007-8 global financial crisis.

1. Introduction

1.1. Background

“For weeks, Wall Street wondered whether Moody's Investors Service, Standard & Poor's and Fitch's, the three major agencies rating corporate debt, would drop Enron's rating below investment grade.”

---- The New York Times, 2001

The above extract is indicative of the criticism the three principal Credit Rating Agencies (CRAs) received during and after the 2001-2 high profile corporate collapses. In the case of Enron, all three principal CRAs downgraded the company below the investment grade by the time its acquisition deal failed, and default was more than likely. The case of Enron was the reason that corporate financial officers and treasury professionals in the US blamed the lack of competition in the CRA industry (Association for Financial Professionals, 2002). The criticism for the industry, which is dominated by a small number of major agencies was for the lack of incentives to timely respond to the needs of credit rating users. The additional increases in defaults in the 2001–2002 period, gave rise to significant criticism to the three principal CRAs’ slow reaction and as a result timeliness of ratings came under closer scrutiny and criticism.

But this was not the only instance that the three principal CRAs were criticized for their inertia. The rather sudden meltdown in Asian countries and corporations that took place a few years before in 1997-8, had also drawn much attention by the media and policymakers. Moreover, the Asian crisis of 1997-8 had been followed by Russia in 1998 and Brazil in 1999, and again much attention was drawn by the media and policymakers mainly on sovereign credit ratings. For the Asian crisis, CRAs have been criticized for failing to predict the coming crisis, and for exacerbating the crisis when they excessively downgraded the countries in the midst of the financial turmoil. Interestingly enough, the International Monetary Fund in 1998 highlighted that no sovereign credit rating was downgraded throughout 1996 and the first half of 1997 for the East Asian countries, with the exception of Thailand by Moodys in April 1997. During the crisis, Indonesia, Korea and Thailand were downgraded to below investment-grade.

In the 2007-2008 financial crisis the role of the three principal CRAs once again came under increased scrutiny. Similar to previous instances, but probably

this time for different reasons, many banks that failed during the crisis enjoyed investment grade ratings just before defaulting. The case of Lehman Brothers, reminds the case of Enron, as Lehman Brothers, an investment bank with a 158-year history, on Monday, September 15th, 2008 filed for Chapter 11 bankruptcy, while Lehman Brothers' bonds were rated "A", an investment grade. Similar situations existed for ratings of bank products and as a result the overall impression has been that the entire rating system was flawed. Posch (2011) claims that is the credit crisis of 2007–2009 showed the dark side of stability.

However, Basel Committee on Banking Supervision (2000) has highlighted the fact that credit ratings are not estimates of short-term default risk but should rather be characterized as looking through the over the cycle estimates of default risk. For example, Moody's has historically intended to preserve a rating system characterized by stable ratings, with a time horizon extending to several years and an intention to "rate through the cycle" (Mahoney, 2002). The result of Moody's dialogue with market participants after the 2001-2 corporate events supported their "rating through the cycle" philosophy (Cantor and Mann, 2003). In this manner, a partial explanation for the investment grade ratingsEnron enjoyed when it collapsed could be the well observed phenomenon in literature (Carey and Hrycay, 2001; Löffler, 2004; Altman and Rijken, 2004) of through-the-cycle ratings. According to Altman and Rijken (2004), this through-the-cycle methodology that rating agencies use is a well-accepted explanation for the perception of some investors that rating agencies are slow in adjusting their ratings. In this way ratings exhibit a much larger stability rather than would current-condition ratings because ratings are intended to be a measure of default risk over long investment horizons . According to Cantor and Mann (2003), Moody's corporate bond ratings' two key characteristics are accuracy and stability, and the performance of Moody's ratings should be measured by those two characteristics. Accuracy is about the correlation between ratings and defaults and stability is about the frequency and magnitude of ratings changes.

1.2. Motivation

Accuracy and stability in corporate credit ratings have been assessed, even though limited, especially after the 2001-2 high profile corporate collapses (e.g. Cantor and Mann, 2003; Löffler, 2004; Altman and Rijken, 2004). However, in the aftermath of the 2007-8 global financial crisis, no similar assessment can be found

in the literature for accuracy and stability in corporate credit ratings. After the 2007-8 global financial crisis, literature on credit ratings focused in aspects such as rating quality over the business cycle and incentive problems between rating agencies and rating users (e.g. Mathis, McAndrews, and Rochet, 2009; Bolton, Freixas, and Shapiro, 2012; Bar-Isaac and Shapiro, 2011). But since credit rating agencies faced increased pressure from regulatory authorities and criticism from investors and academics, it would be interesting to examine how credit rating agencies rated before the 2007-8 global financial crisis and also how they responded to that pressure and criticism in the aftermath of the crisis, with respect to accuracy and stability.

Moreover, in the scant literature for bank ratings, research focuses mainly on bank rating quality and its variation within business cycles (e.g. Hau, Langfield and Marques-Ibanez, 2012). So, there exists no literature that specifically examines accuracy and stability in bank ratings, even before the 2007-8 global financial crisis. But, since literature in accuracy and stability of corporate credit ratings have given us important insights, it is interesting enough to examine accuracy and stability in bank ratings, not only before and after the 2007-8 global financial crisis, but even before that periods. Overall, our findings from our previous essay on structural shifts in bank credit ratings give us motivation, similarly to Cheng and Neamtiu (2009), to explore the existence of accuracy and stability in bank credit ratings and how those two properties have been affected by the heavy criticism towards the three principal CRAs on all different occasions during the past two decades.

1.3. Aim and Research Questions

The aim of this essay is to fill the two-fold gap in literature for the existence of accuracy and stability in bank ratings and for the changes, if any, of those properties in bank ratings, not only before and after the 2001-2 high profile corporate collapses, but also for the 2007-8 global financial crisis. Those two properties of credit ratings are important because they affect rating agencies' decisions for all credit ratings, i.e. these two properties are a part of rating standards (Cantor and Mann, 2003). Also, the response of rating agencies to financial historical events combined with the pressure and criticism that rating agencies receive affect rating standards and hence accuracy and stability (Cantor and Mann, 2006),

In order to explore the mechanism that affects the two conflicting goals of accuracy and stability in bank ratings, we should take into account that higher rating stability compared to accuracy, means that credit quality changes but the ratings do not. Credit ratings are changed only when agencies are confident that observed changes in an entity's risk profile are likely to be permanent (Altman and Rijken, 2004). So, timeliness in credit ratings affects accuracy and it is in fact the most criticized aspect of ratings (Cheng and Neamtiu, 2009). But, if ratings lack of timeliness then there should be a factor that can be quantified and affects credit quality. So, we name this factor that simultaneously and indirectly affects rating accuracy and stability as rating stickiness, since if either credit quality changes but the ratings do not or credit ratings are characterized by slow respondence then we consider that ratings are sticky.

This essay aims to shed light on the timeliness and accuracy of bank credit ratings, by examining stickiness. In more detail we will attempt to answer the following questions:

1) Is there stickiness in bank credit ratings and does it differ across all three principal CRAs?
2) If stickiness exists in bank ratings, is it symmetric or asymmetric for upgrades and downgrades?
3) If stickiness exists in bank ratings, is it the same or different in higher versus lower credit quality bank ratings?
4) If stickiness exists in bank ratings, is it constant over time across all three principal CRAs?
5) How does the criticism after the 2001-2 high profile corporate collapses and in the aftermath of the 2007-8 global financial crisis affected stickiness in bank credit ratings?

2. Literature Review

Before investigating empirical literature on credit ratings and the strand of literature that focuses on their accuracy and stability, we will present a short review of the theoretical literature on credit ratings. Theoretical literature for credit ratings focuses on the role of CRAs as information intermediaries, and consequently it is related to the literature on information intermediaries. In this way CRAs are motivated by reputation costs in order to provide accurate information. Most of the early theoretical literature (Kuhner, 2001; Boot, Milbourn and Schmeits, 2006; Farhi, Lerner and Tirole, 2008) consider non-strategic CRAs, i.e. agencies that do not strategically build on their reputation so as to later on inflate their ratings to gain more business by their clientele, and eventually more profits. Later studies that came during and after the global financial crisis of 2007-8, mostly examined the framework of a strategic CRA in a dynamic model. Mathis, McAndrews, and Rochet (2009) and Bolton, Freixas, and Shapiro (2012) are two of the most cited papers within this framework. Two of the main conclusions of Bolton, Freixas, and Shapiro (2012) is that competition among CRAs reduces efficiency because of rating shopping and that ratings can be inflated in good times of economic expansion, implying countercyclicality of ratings. Similarly, Bar-Isaac and Shapiro (2013) use a dynamic model of credit ratings to obtain insights on ratings' quality over the business cycle. The authors find that ratings quality is countercyclical, i.e. booms have lower quality ratings than do recessions, due to the incentive of CRAs to ”milk” the reputation built during in lean times. Additional factors that reduce ratings quality are increased fee-income, high competition for analyst in the labour market during booms, and naive investors in the market. In a different context, Bar-Isaac and Shapiro (2011) model the labour market for rating analysts to explore their incentive problem that was spotted before the global financial crisis. The authors' main finding is that ratings accuracy is likely to be countercyclical due to the labour market structure. So, for the scope of this study, the common finding in most of the theoretical literature on credit ratings for the countercyclical character of rating accuracy is quite interesting.

Empirical literature on credit ratings mainly focuses on informativeness, perceived bias, and changes of rating standards over time. A number of studies focuses on the last subtopic of changing rating standards in an attempt to explain the reported declining credit quality observed since the 1990s. Blume, Lim, and Mackinlay (1998) is one of the early studies and one of the most cited in the strand

in the literature that investigates the changes in rating standards over time. The authors find that the declining credit quality from 1978 to 1995 is not fully explained by changes in credit quality, and that it is partly explained by an apparent stringency in the rating standards by the CRAs. In this way, the authors attribute at least a part of the downward trend in credit ratings in the CRAs' conservatism. Alp (2013) is study very much related in Blume, Lim, and Mackinlay (1998) that not only also finds stringency in declining credit quality but also quantifies this effect. The main findings by Alp (2013) are that from 2002 to 2007 a structural shift occurs towards stringency by 1.5 notch drop in rating standards, and that from 1985 to 2002 a "divergent pattern" exists between investment-grade and speculative-grade rating standards, i.e. investment-grade standards tighten and speculative-grade standards loosen. Similar to Alp's (2013), Baghai, Servaes, and Tamayo (2014) find that CRAs have become more stringent or conservative during the period 1985 to 2009, with average ratings dropping by 3 notches. According to the authors, this finding is not consistent with the observed decrease in the default rates during this period. Contrary to all the above findings for stringency or conservatism in rating standards there is a study by Jorion, Shi, and Zhang (2009). The authors, similar to Alp (2013), find that the downward trend in rating standards do not apply to speculative-grade issuers, but contrary to all the above studies for the changes in rating standards, the apparent tightening of rating standards can be mainly attributed to the temporal decline in accounting quality.

However, the above strand of studies that relies either on the ordered probit or logit models mainly suffers from the criticism of ignoring the time-varying nature of rating standards and the effect of omitted variables (Blume et al., 1998; Shumway, 2001; Alp, 2013). Shumway (2001) also criticizes the static model for its timeliness bias, as there is no dynamics of the rating mechanism to explain rating migrations. Most of the models in the above strand of studies use rolling average covariates that lack of the necessary dynamics which are essential to reflect the true level corresponding the explanation of the migration mechanism.

Empirical literature on bank credit ratings is sparse (Salvador, Pastor and Fernandez de Guevara, 2014), as few studies for credit ratings focus exclusively on bank ratings. One of the early studies in this strand of the literature is by Cantor and Packer (1995), who find evidence that CRAs disagree more about bank ratings that non-financial firm ratings. Hau, Langfield and Marques-Ibanez (2012) is one of the most comprehensive studies of the information content of bank credit ratings. The authors use an international sample of approximately 39,000

quarterly bank ratings over the period 1990–2011 from the three principal CRAs and find that bank rating quality is countercyclical, i.e. information content of credit ratings is higher during banking crises, and that bank ratings in the upper investment grade range do not correspond to their expected default probabilities, i.e. are less risky. Van Laere, Vantieghem and Baesens (2012) find that S&P have stricter bank rating standards compared to Moody's, while Moody's standards are more sensitive to the economic climate. Salvador, Pastor and Fernandez de Guevara (2014) examine the Spanish banking sector for ratings during 2000-2009 and find that ratings are procyclical as the worsening of bank credit ratings that followed the global financial crisis of 2007-8 is partly attributed to the hardening of rating standards. The findings of the three last studies on bank ratings, i.e. for the countercyclical rating quality, the sensitivity of standards to the economic climate and the procyclical bank ratings, are also interesting for the scope of this study. However, there is no empirical literature for the timeliness and accuracy of bank credit ratings.

Studies, such as that by Blume, Lim, and Mackinlay (1998), Jorion, Shi, and Zhang (2009) and Alp (2013), even though they attribute the observed rating deterioration to time-varying rating standards, cannot put a definitive end to the debate. The stream of literature on the stability of credit ratings or timeliness of rating policies, and the stability of credit ratings through business cycles is a well observed phenomenon (Carey and Hrycay, 2001; Löffler, 2004; Altman and Rijken, 2004). This phenomenon is also called in literature as through-the-cycle ratings and it the situation that rating updates fall behind variation of credit quality, and consequently affect the accuracy of ratings. Carey and Hrycay (2001) study empirically internal bank ratings and compare them to agency ratings. The authors conclude that agency ratings demonstrate less cyclical variation and are more stable than the current condition, point-in-time ratings, which are used by most bank's internal rating system. Löffler (2004) using a structural model of default find that observed empirical irregularities of credit ratings can be the result of a separation of permanent and cyclical components of default risk, a method required according to the author for the through-the-cycle in ratings employed by most of the CRAs. Furthermore, the author finds that ratings through-the-cycle are highly stable, but their default prediction is low. Altman and Rijken's study (2004) is the first in a number of studies that goes beyond the through-the-cycle explanation for rating stability, i.e. ratings being changed only when the CRAs being confident that the observed changes in the entity's risk profile have a

permanent character. According to the authors, long investment horizons explains only part of the relative stability of agency ratings. The other part of the through-the-cycle in the CRAs' methodology is a certain threshold level that rating migrations are triggered when the actual through-the-cycle credit quality exceeds by 1.25 notches the average credit quality for a given rating class. Posch (2011) further extends the modelling of threshold levels on rating migrations by extending the model with frictions to allow for non-constant thresholds. The default probability must change by at least two notches before a CRA reacts, while the timeliness changes across the rating spectrum and over the years. Also, it is interesting that during periods with high defaults and for low credit quality of rated entities, CRAs tend to rate more timely. In the same context, stickiness has been also been observed in sovereign ratings. Mora (2006) investigates the behavior of sovereign credit ratings in the context of the East Asian crisis to question the widely held view that ratings were procyclical and concludes that sovereign ratings were sticky. However, Auh (2015) provides evidence that credit ratings are procyclical, by examining a sample of U.S. corporate bond ratings from 2002 to 2011.

Finally, Cheng and Neamtiu (2009) examine the quality of ratings with respect to timeliness, accuracy and stability before and after the Sarbanes-Oxley Act (SOX). This act in the US Senate came as a result for the high-profile bankruptcies of 2001-2 and is considered by the authors to have increased the regulatory pressure and criticism to CRAs. The authors define two periods, the period before SOX (1 January 1996 - 25 July 2002) as the pre-criticism period and the period after SOX (25 July 2002 - 31 Dec 2005) as the criticism period, while using credit ratings by the three principal CRAs. They find that the average ratings of defaulted companies one-year period leading to default are lower in the criticism period compared to pre-criticism period. So, they conclude that CRAs improved both timeliness and accuracy of their ratings after SOX, while also reducing rating volatility. According to the authors this combination is achieved by the CRAs through the improvement of their credit analysis and not by sacrificing one characteristic for the other as CRAs have suggested through the potential trade-off (Cantor and Mann, 2003; Cantor and Mann, 2006).

3. Stability and Accuracy in Bank Rating Methodologies

It is a general observation, that CRAs are obliged to balance two conflicting goals: rating stability and rating accuracy (Posch, 2011). For this reason, CRAs have spent significant resources to investigate and to demonstrate to market participants, i.e. investors, issuers and regulators, that a balance among the two rating characteristics is necessary.

In early 2002, Moody's initiated a dialogue with all market participants for issues of credit quality in the aftermath of recent events that included the September 9th 2001 terrorist attacks in the US, the global economic contraction, and the 2001-2 high profile corporate collapses (Mahoney, 2002a). Moody's expected feedback from market participants regarding potential changes to their rating processes, due to the increase in the frequency or extent of recent rating adjustments which had resulted from the volatile credit environment caused by the recent events. This dialogue continued for some months (Mahoney, 2002b; Fons, Cantor and Mahoney, 2002), and Moody's concluded that market participants generally desire rating stability and no changes such as increasing the frequency of rating changes without reviews and streamlining or eliminating rating outlooks were necessary (Fons, Cantor and Mahoney, 2002). Another conclusion of this dialogue was that market participants supported greater disclosure by Moody's of how they arrived at their ratings and why they change them, so Moody's developed some metrics that can be used to measure the rating system performance.

Ratings accuracy is described by Moody's as the correlation between ratings and the risk of default, while stability is described as the frequency and magnitude of rating changes, but also the likelihood that a rating will prove to be enduring (Cantor and Mann, 2006). Cantor and Mann (2006) focus on two metrics respectively for accuracy and stability, the one-year-horizon accuracy ratio[18] and the share of ratings that remain unchanged over the course of a year, but for the EDF-implied ratings[19]. According to Moody's (Cantor and Mann, 2006), their rating

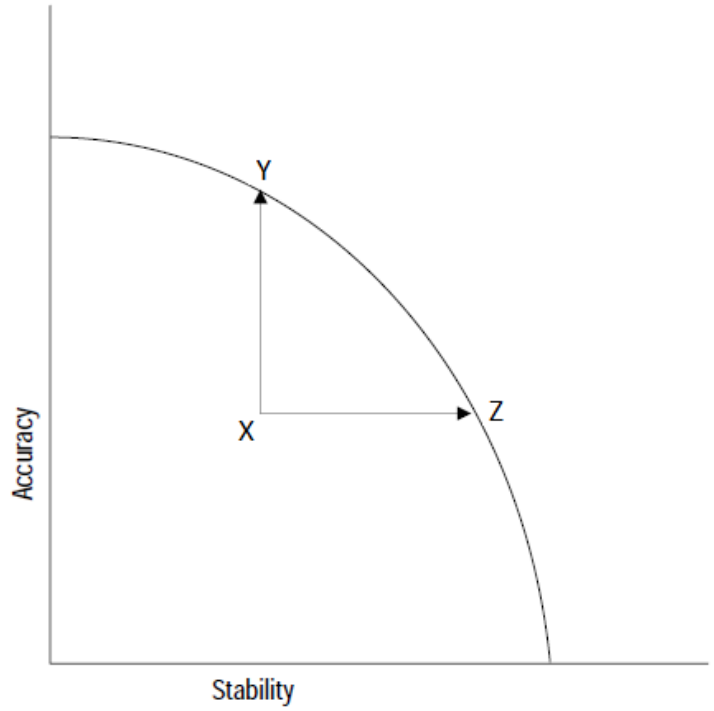
[18] The accuracy ratio (AR) is defined in Cantor and Mann (2003) and is measure of relative accuracy of Moody's ratings that compress the information in the cumulative accuracy profile (or power curve) into a single number.

[19] EDF-implied ratings are "credit ratings" mapped from EDFs (Expected Default Frequency) credit measure by Moody's, which measure the probability that a firm will

system embodies a tradeoff between accuracy and stability that apparently meets the needs of ratings users as at a one-year horizon, their ratings are slightly less accurate, but they are more accurate at longer horizons.

Figure 2.1

The Accuracy/Stability Frontier



Source: Cantor and Mann (2006)

Figure 2.1 demonstrates the tradeoff between accuracy and stability at a one-year horizon again according to Cantor and Mann (2006). A move from point X to point Z, or from X to Z is thought as an improvement in the methodology that increase the accuracy or stability, but a movement from Y to Z or the opposite is thought as a movement in the Accuracy/Stability Frontier. In such a case a movement from Y to Z is thought as improving accuracy at the expense of stability while a movement from Z to Y is thought as improving stability at the expense of accuracy. Cheng and Neamtiu (2009) use a similar figure to not only show the "parallel" movement as explained in the above figure, but also the prospect of expanding the Accuracy/Stability Frontier by improving credit analysis. However, it is important to note that no matter how much the frontier is pushed out, there will always be a trade-off decision between accuracy and stability.

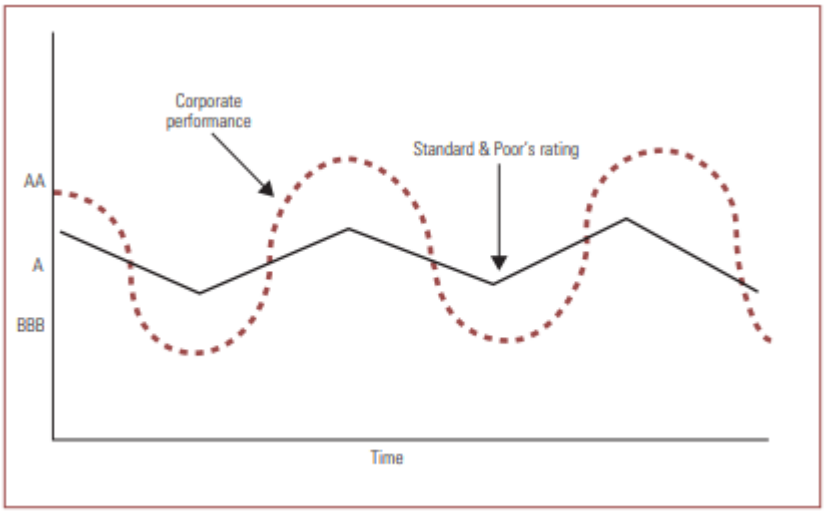
default over a specified period of time. EDF-implied ratings are called Market Implied Ratings (MIR) since 2010.

In its latest effective rating definitions (Moody's, 2019), we observe an altered definition of stability by the rating agency. Moody's states that their rating methodologies contain key rating assumptions (KRAs) that are fixed inputs and involve assumptions such as that there is very strong interdependence. KRAs are expected to a degree of stability in credit ratings as the change in in response to long-term structural changes, and they are unlikely to change as a result of a short-run change in economic or financial market conditions. So, given that in Moody's latest effective rating definitions there are no references for the trade-off between stability and accuracy as we observed existed after the 2001-2 high profile corporate collapses and before the global financial crisis of 2007-8, we conclude that there has been a change in the agency's assessment for stability and accuracy.

The other major market player in the ratings market, i.e. Standard and Poor's, has mainly through their older published rating criteria repeatedly expressed the attribute of rating stability. Standard and Poor's considered as ideal to rate 'through the cycle' as they consider that there is no point in assigning high ratings to a company enjoying peak prosperity if that performance level is expected to be only temporary. Similarly, there is no need to lower ratings to reflect poor performance if it can be reliably anticipated that better times are just around the corner (Standard & Poor's, 2002). Also, in subsequent published rating criteria, Standard & Poor's (2003) expressed the position that ''the value of its products is greatest when its ratings focus on the long term and do not fluctuate with near term performance". In a subsequent published ratings criteria (Standard & Poor's, 2006), Standard and Poor's again expressed that it is ideal to rate "through the cycle", i.e. holding constant ratings throughout the cycle, or, allowing ratings to vary within a narrow band. However, they recognized the fact that rating through the cycle requires an ability to predict the cyclical pattern which is difficult to do, but also that even in predictable cycles there may be a lasting impact on credit quality. Therefore, ratings may be adjusted within the phases of a cycle, with the typical relationship of ratings and cycles like that in Figure 2.2.

Figure 2.2

Rating through the cycle



Source: Standard and Poor's, Corporate Ratings Criteria 2006.

On May 3, 2010, Standard and Poor's published a criteria article named "Credit Stability Criteria" (Standard and Poor's, 2010) to highlight the fact that their global rating methodology incorporates credit stability as an important factor in its rating opinions. Nevertheless, this criteria article, which is still effective, involves an asymmetric definition as it concerns solely the event of credit deterioration due to moderate stress conditions[20] over a one-year and three-year horizons. For example, according to the table in the article, a rating of 'AA' would not be assigned to an entity if it has high likelihood to fall below 'A' within one year under moderate stress conditions, or below 'BB' within three years.

In its latest effective rating definitions (Standard and Poor's, 2009; Standard and Poor's, 2011), Standard & Poor's refers to credit stability as a secondary credit factor[21] as defined in the above criteria article "Credit Stability Criteria". So, similarly as for Moody's, given that in Standard and Poor's latest effective rating definitions there are no references for rating through the cycle as we observed existed after the 2001-2 high profile corporate collapses and before the global financial crisis of 2007-8, we conclude that there has been a change in the agency's assessment for stability.

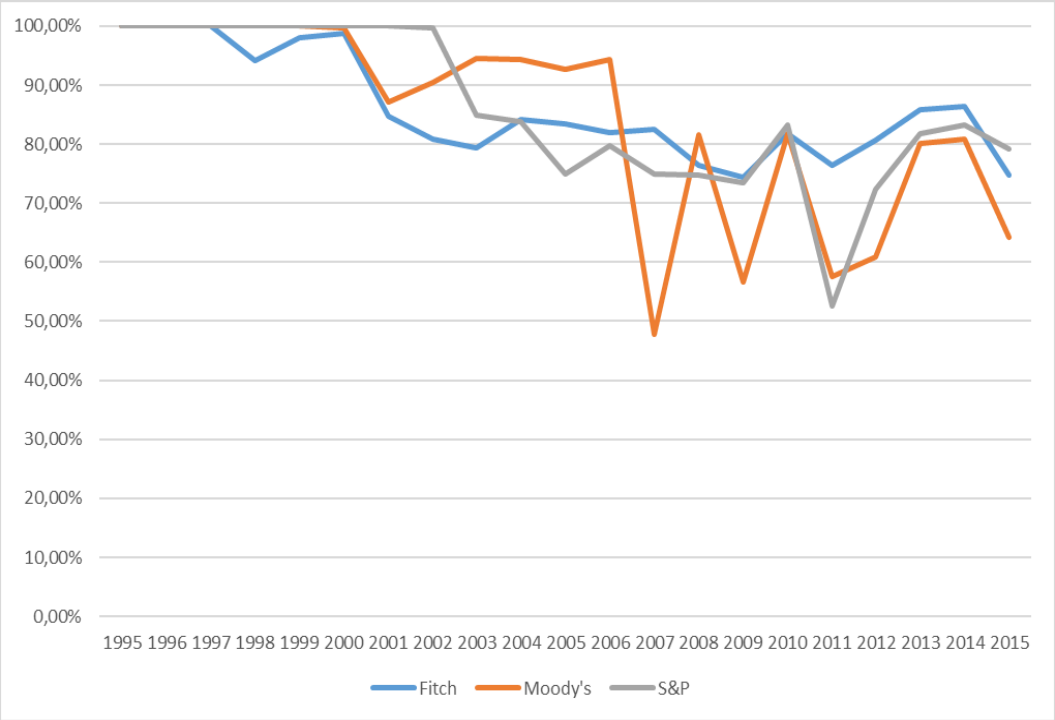
Given all the aforementioned for how the two major market players in the CRA industry has evolved their assessment in their rating methodologies for rating stability and accuracy, it is noteworthy to have a foretaste of bank rating data about rating stability which is more readily observable. In Figure 2.3 we present the

[20] Moderate stress conditions are defined as the U.S. recession of 1982 and the U.K. recession in the early 1990s.
[21] The single most important dimension of creditworthiness is the likelihood of default, while

metric employed by Moody's (Cantor and Mann, 2006) to assess rating stability: Rating Action Stability Rate. The Rating Action Stability Rate is the average fraction of issuers whose ratings are unchanged over any twelve-month period. The data used are in Figure 2.3 are from our world sample of bank ratings by the three principal CRAs from 1995 to 2015, which is analysed in the next section.

Figure 2.3

Average yearly Rating Action Stability Rate for calendar years from 1995 to 2015, for the three principal CRAs



According to Cantor and Mann (2003), in a typical year, less than a quarter of issuers rated experience a rating change of any type[22], which in other words means that the Rating Action Stability Rate is expected to be more than 75%. The findings in Figure 2.3 are quite interesting. First, we observe that until year 2000, the average yearly Rating Action Stability Rate for bank ratings for Standard and Poor's and Moody's is 100% and for Fitch is very close to 100%. For Standard and Poor's the Rating Action Stability Rate is 100% until 2002. From year 2001 until 2006, we observe a shift towards a rather varying Rating Action Stability Rate in the bank ratings of all three principal CRAs. Lastly, from year 2007 for Moody's and from 2011 for Standard and Poor's, we observe a sharp increase in the volatility of the Rating Action Stability Rate of their bank ratings. Overall, we can

[22] The authors also mention that less than five-percent of issuers experience large rating changes, and only about one-percent of issuers experience a reversal of a previous rating change.

say that from 1995 to 2015, Fitch is the CRA that experiences the most stable Rating Action Stability Rate for its bank ratings, while the opposite for Moody's. Nevertheless, the above findings may or may not entail a change in rating stability and accuracy, since there may other factors affecting bank ratings and thus further investigation is necessary.

4. Stickiness in bank ratings

4.1. Introduction

This essay aims to investigate whether bank ratings are sticky. We use an international sample of banks that cover a period of more than 20 years, until 2015, and assess aspects of the dynamic behaviour of bank ratings by all three principal CRAs. Initially we will investigate if bank ratings are sticky, and in case that there are signs of stickiness we shall attempt to examine whether stickiness is different in the event of a downgrade and an upgrade decision by the three CRAs. We shall also examine whether stickiness is asymmetrical for investment grade and speculative grade ratings. Furthermore, given the broad time horizon of our sample, we are in a position to examine whether stickiness is constant during the time horizon that our sample covers, since during this period we have had many incidents of failures that were partly attributed to bad practices by CRAs.

4.2. Empirical Strategy

In order to investigate whether bank ratings are sticky, we estimate an ordered logit model where bank ratings are modelled as a function of a set of financial explanatory variables and a dummy variable in order to capture the effect of stickiness. The model is:

$$R_{it} = \begin{cases} 17 & \text{if } Z_{it} \in [\mu_{16}, \infty) \\ 16 & \text{if } Z_{it} \in [\mu_{15}, \mu_{16}) \\ 15 & \text{if } Z_{it} \in [\mu_{14}, \mu_{15}) \\ \vdots & \\ 3 & \text{if } Z_{it} \in [\mu_{2}, \mu_{3}) \\ 2 & \text{if } Z_{it} \in [\mu_{1}, \mu_{2}) \\ 1 & \text{if } Z_{it} \in (-\infty, \mu_{1}) \end{cases} \quad (1)$$

$$Z_{it} = \beta' X_{it} + \gamma S_{it} + \varepsilon_{it} \quad (2)$$

The first part corresponds to the 17 rating categories, as explained in the next section, where R_{it} denotes the credit rating of bank *i* at quarter *t* according to the

latent variable Z_{it} and the partition points μ_i that distinguish each rating category. The second part, relates the latent variable with the explanatory variables, β is the vector of slope coefficients and X_{it} is vector of the financial explanatory variables of bank *i* at quarter *t*, and lastly S_{it} is the dummy variable necessary to capture the effect of stickiness and γ its coefficient. Variable S_{it} takes the value of 1 if in any of the next 4 quarters, i.e. at *t+1*, *t+2*, *t+3* and *t+4*, the bank's *i* credit rating is changed, i.e. upgraded or downgraded. In this way we choose four quarters or one year to check for the existence of stickiness in bank ratings. According to the CRAs' rating practices it is ideal to rate "through the cycle" (Standard & Poor's, 2006), which is translated that the tradeoff between accuracy and stability that apparently meets the needs of ratings users is within a one-year horizon (Cantor and Mann, 2006). So, we expect that if there exists stickiness in bank ratings it should be sought in the one-year window before a rating change takes place.

Conditional on the presence of stickiness, our analysis will be extended as dummy variable S_{it} will be replaced by two such variables DS_{it} and US_{it} to examine whether stickiness is different in the event of a downgrade and an upgrade decision. In this way equation (2) becomes:

$$Z_{it} = \beta' X_{it} + \gamma DS_{it} + \delta US_{it} + \varepsilon_{it} \qquad (3)$$

DS_{it} takes the value of 1 if in any of the next 4 quarters, i.e. at *t+1*, *t+2*, *t+3* and *t+4*, the bank's *i* credit rating is downgraded, and in all other instances, DS_{it} takes the value of 0. The expected sign of coefficient γ of DS_{it} is positive because if over the next 4 quarters a downgrade takes place, the presence of stickiness inflates the currently reported rating. E.g. if the current rating of bank *i* at time *t* is A-, which is translated to 10 according to the rating transformation we define, and in the next 4 quarters a one notch downgrade to BBB+ takes place, which is translated to 9, then the stickiness effect, if there exists one, has a positive effect on the ratings at time *t*, that preserve the rating to this higher level. Conversely, US_{it} takes the value of 1 if in any of the next 4 quarters, i.e. at *t+1*, *t+2*, *t+3* and *t+4*, the bank's *i* credit rating is downgraded. In all other instances, US_{it} takes the value of 0, and the expected sign of coefficient δ of US_{it} is negative because if in the next 4 quarters an upgrade takes place, the presence of stickiness deflates the currently reported rating. In this way, we choose two variables to capture the effect of stickiness because we expect different signs in case of an upcoming downgrade or upgrade, but also the stickiness effect may be different on each occasion.

4.3. Sample and variables

In order to proceed with our empirical analysis, we use Bankscope database as the source for bank ratings and financial variables. Bankscope database has information on more than 20,000 banks from all over world, but in order to have homogeneity in our sample, we apply three selection criteria in Bankscope with respect to size, bank's specialization and ultimate owner criterion. We only consider banks that have book value of assets greater or equal to $5bill. in 2006 (i.e. the year before the global financial crisis begun) or in the last year that bank's data are available. The reason we use the size criterion is that on the one hand to screen out smaller banks that are rarely rated and on the other hand to have a global sample that accounts for most of the global banking system. For the specialization criterion we choose only values of Commercial Banks, Savings Banks, Cooperative Banks and Bank Holding & Holding Companies (BH&HCs), so as to maintain homogeneity in our sample by concentrating broadly on commercial banks (i.e. excluding investment banks, custodian banks, etc). Lastly, we apply the ultimate owner criterion in order to avoid double-counting ratings of banks that are junior within a single ownership structure.

The credit ratings of banks by each of the three principal CRAs we choose to use in our analysis are the long-term issuer ratings which are used in all related literature for bank ratings (e.g. Hau, Langfield and Marques-Ibanez, 2012; Van Laere, Vantieghem and Baesens, 2012; Salvador, Pastor and Fernandez de Guevara, 2014). The long-term issuer ratings are the primary issuer ratings of each CRA and in particular for Fitch we use their the long-term issuer default rating (IDR), for Moody's we use their long-term Issuer rating (foreign) and for Standards and Poor's we use their foreign currency long-term Issuer Credit Rating (ICR).

Our full sample of bank ratings by all three CRAs totals approximately 90,000 quarterly ratings and it is an unbalanced panel that spans from 1988 to 2015 (we start at 1988 because available financial data start at this year). The full sample is analysed in Table 4.1.

Table 4.1: Credit Ratings per World Region/CRA

World Region	Fitch	Moody's	S&P	Grand Total
Europe	13,335	12,940	11,846	38,121

US & Canada	6,931	7,238	7,716	21,885
RoW	9,903	10,974	8,857	29,734
	30,169	31,152	28,419	89,740

All credit ratings obtained are transformed from their letter form into a numerical value that corresponds to an ordinal scale. In all related literature for credit ratings we find studies that use ordinal scales from 4 categories to 17 categories. E.g. Blume, Lim, and Mackinlay (1998) use an ordinal scale of 4 categories, whereas Van Laere, Vantieghem and Baesens (2012) use an ordinal scale of 17 categories. Given the size of each of our three subsamples, i.e. each CRAs subsample, we choose to use an ordinal scale of 17 categories, according to the Table 4.2.

Next we choose to use six financial variables that are mostly found in related literature for bank ratings (e.g. Hau, Langfield and Marques-Ibanez, 2012, Van Laere, Vantieghem and Baesens, 2012), but also in CRAs' methodologies (Fitch, 2018; Moody's, 2018). Those financial characteristic variables cover bank size, profitability, leverage, asset structure and funding structure. For bank size we the natural log of total assets, for profitability we choose Return on Average Assets (ROAA), for leverage we choose Total Assets divided by Equity, for asset structure is measured by both Net Loans divided by Total Assets, and for funding structure we choose Deposit & Short-term Funding divided by Total Assets, and also Other Operating Income divided by Average Assets.

Lastly, we use as explanatory variable the sovereign credit rating to proxy the external support element according to CRAs' methodologies (Fitch, 2018; Moody's, 2018), something that is also found in related literature (Van Laere, Vantieghem and Baesens, 2012; Salvador, Fernández de Guevara and Pastor, 2018). In this way sovereign credit rating proxies not only the external support as considered by the CRAs in the long-term issuer ratings, but also the economic environment of the bank. So, we choose the sovereign credit rating by the same CRAs and the equivalent time periods (i.e. if we have a bank rating for a bank at period *t* by Fitch, we obtain the bank's country credit rating by Fitch again for period *t*).

Summary statistics for Bank Credit Ratings and the Explanatory Variables are presented respectively in Tables 4.3 and 4.4.

Table 4.2: Rating Transformation Table

Fitch	Rating Scale Number	Moody's	Rating Scale Number	S&P	Rating Scale Number
AAA	17	Aaa	17	AAA	17
AA+	16	Aa1	16	AA+	16
AA	15	Aa2	15	AA	15
AA-	14	Aa3	14	AA-	14
A+	13	A1	13	A+	13
A	12	A2	12	A	12
A-	11	A3	11	A-	11
BBB+	10	Baa1	10	BBB+	10
BBB	9	Baa2	9	BBB	9
BBB-	8	Baa3	8	BBB-	8
BB+	7	Ba1	7	BB+	7
BB	6	Ba2	6	BB	6
BB-	5	Ba3	5	BB-	5
B+	4	B1	4	B+	4
B	3	B2	3	B	3
B-	2	B3	2	B-	2
CCC+	1	Caa1	1	CCC+	1
CCC	1	Caa2	1	CCC	1
CCC-	1	Caa3	1	CCC-	1
CC	1	Ca	1	CC	1
C	1	C	1	C	1
RD	1			R	1
D	1			SD	1
				D	1

Table 4.3: Summary Statistics for Bank Credit Ratings

	Fitch			Moody's			S&P		
	Mean	Std Dev	Obs	Mean	Std Dev	Obs	Mean	Std Dev	Obs
World Sample	9.23	3.32	30,169	9.71	3.62	31,152	9.71	3.22	28,419
Europe	10.08	3.17	13,335	10.35	3.57	12,940	10.63	3.15	11,846
US & Canada	9.66	3.16	6,931	10.83	2.93	7,238	9.92	2.80	7,716
RoW	7.78	3.15	9,903	8.21	3.61	10,974	8.32	3.16	8,857

Table 4.4: Summary Statistics for Financial Explanatory Variables

	World Sample		Europe		US & Canada		RoW	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Log of Assets	7.07	0.73	7.08	0.72	7.08	.67	7.05	0.77
R.O.A.A.	.809	2.87	0.52	2.87	0.96	2.28	1.10	3.08
Total Assets/Equity	18.34	318.13	26.12	337.12	11.95	14.88	11.82	367.2
Net Loans/Tot. Assets	58.01	17.96	59.02	19.30	61.35	16.95	55.15	16.2
Dep.&Funding/Tot Assets	153.95	786.36	163.61	585.97	173.91	1609.2	132.64	121.0
Oth.Op.Income/Avg Assets	1.64	3.57	1.37	3.64	2.39	4.72	1.59	2.64

4.4. Empirical Results

In this Subsection, initially we estimate the ordered logit model of equations (1) and (2) for the full world sample of banks, for each CRA, to investigate in the first place if bank ratings are sticky. Then we estimate the ordered logit model of equations (1) and (3), for each CRA, to investigate whether stickiness is different in the event of a downgrade and an upgrade decision. Our analysis continues for investment grade and speculative grade bank ratings and concludes with different time periods and structural breaks.

The coefficient estimates for all explanatory variables in all our models are informative with respect to their signs, but they are uninformative with respect to the magnitude each variable affects bank ratings. So, just by observing the coefficient estimates it is difficult to infer economic significance, except for their signs. Following Alp (2013), in order to infer economic significance, we calculate the average notch effect of all explanatory variables. For the non-dummy explanatory variables, we calculate the product of the estimated coefficient and each variable's standard deviation, divided by the average distance between the rating categories or cut points, i.e. the average notch length[23]. The product of the coefficient and the standard deviation measures the change in the conditional expectation in the latent variable given one standard deviation increase in the explanatory variable. Similarly, for the dummy variables we calculate their coefficients as multiples of the average distance between the rating categories, or as explained previously, the average distance between cut points. The average notch effect is displayed next to each variable's coefficients and z-stat, in columns three and four in all the results tables that follows.

4.4.1. Results for Preliminary Analysis

The results of our preliminary analysis model of equations (1) and (2) are presented in Table 4.5. We observe that the coefficients of almost all financial explanatory are uniformly statistically significant and having the same expected signs across CRAs. In particular, Log of Assets and R.O.A.A. are highly significant

[23] The average rating notch length is calculated as $(\mu_{16}-\mu_1)/15$, where μ_{16} is the last cut point (i.e. the cut point that distinguishes the 16th and the 17th rating categories), μ_1 is the first cut point (i.e. the cut point that distinguishes the 1st and the 2nd rating categories) and number 15 is the number of the in-between categories.

Table 4.5: Preliminary analysis estimation results for full sample

Estimation results for the ordered logit model of equations (1) and (2) for the full world sample of commercial banks, for each CRA. The dependent variable is equivalently Fitch, Moody's and S&P long-term issuer ratings, and the financial explanatory variables together with the Stickiness dummy are defined above. Standard errors are calculated using cluster-correlated robust estimate of variance at the bank level, and the asterisks *, **, and *** next to the coefficients values respectively correspond to significance levels 10%, 5% and 1%.

Fitch				
Variable	**Coefficient**	**Z stat**	$\frac{\textbf{Coefficient} \times \textbf{SD}}{\textbf{Rating Notch Length}}$	$\frac{\textbf{Coefficient}}{\textbf{Rating Notch Length}}$
Log of Assets	1.175***	13.46	0,78	
R.O.A.A.	0.118***	3.80	0.23	
Total Assets/Equity	-0.0001***	-9.56	-0.02	
Net Loans/Tot. Assets	-0.011***	-3.29	-0.18	
Dep.&Funding/Tot Assets	-0.001***	-3.05	-0.15	
Oth.Op.Income/Avg Assets	-0.047	-1.14	-0.09	
Country Rating	0.482***	19.88	1.88	
Stickiness	-0.464***	-8.21		-0.44
No. of observations	26,587			
Pseudo R^2	0.183			
Clusters of Banks	777			
Moody's				
Variable	**Coefficient**	**Z stat**	$\frac{\textbf{Coefficient} \times \textbf{SD}}{\textbf{Rating Notch Length}}$	$\frac{\textbf{Coefficient}}{\textbf{Rating Notch Length}}$
Log of Assets	0.863***	8.80	0.67	
R.O.A.A.	0.210***	4.27	0.50	
Total Assets/Equity	-0.001	-0.53	-0.29	
Net Loans/Tot. Assets	0.005	1.15	0.09	
Dep.&Funding/Tot Assets	-0.000*	-1.58	-0.04	
Oth.Op.Income/Avg Assets	-0.134***	-3.55	-0.38	
Country Rating	0.511***	20.98	2.41	
Stickiness	-0.340***	-5.80		-0.40
No. of observations	22,298			
Pseudo R^2	0.163			
Clusters of Banks	746			
Standard and Poor's				
Variable	**Coefficient**	**Z stat**	$\frac{\textbf{Coefficient} \times \textbf{SD}}{\textbf{Rating Notch Length}}$	$\frac{\textbf{Coefficient}}{\textbf{Rating Notch Length}}$
Log of Assets	0.537***	5.33	0.40	
R.O.A.A.	0.202***	3.84	0.45	
Total Assets/Equity	-0.000***	-8.64	-0.02	
Net Loans/Tot. Assets	-0.006	-1.43	-0.11	
Dep.&Funding/Tot Assets	-0.000	-0.38	-0.08	
Oth.Op.Income/Avg Assets	-0.124***	-3.33	-0.57	
Country Rating	0.518***	20.32	2.16	
Stickiness	-0.319***	-5.30		-0.35
No. of observations	26,086			
Pseudo R^2	0.154			
Clusters of Banks	669			

across all three CRAs with positive signs as expected. Total Assets/Equity is significant for

Fitch and S&P, with negative sign as expected, Other operating income/Average Assets is significant for Moody's and S&P, also with negative sign as expected,

and Deposits&Short-term Funding/Total Assets is significant for Fitch and Moody's, again with negative sign as expected. Net Loans/Total Assets is significant only for Fitch with negative sign as expected.

Country Rating coefficients have, again as expected, a positive sign and high significance levels for all three CRAs. Positive sign is expected as higher country credit rating is expected to raise a bank's rating. This reflects the importance of the country's ability and propensity to support a bank in determining the bank's credit rating (Fitch, 2018). Lastly, the Stickiness dummy coefficients strikingly present uniformly a negative sign and with high significance levels for all three CRAs. Negative sign for all the CRAs' Stickiness coefficients is translated as follows: if in any of the next 4 quarters, i.e. at t+1, t+2, t+3 and t+4, a bank's credit rating is changed, i.e. upgraded or downgraded, then this bank's current credit rating is deflated or kept at a lower rating level by the stickiness effect. This is the expected explanation but only for the case of an upgrade. In the case of a downgrade we would expect a positive sign for stickiness implying that the current rating is inflated by the stickiness effect. But since our model of preliminary analysis involves a single variable for stickiness, there is no way to distinguish the effect of stickiness for each of the two cases. What is certain from our model of preliminary analysis is the presence of Stickiness in Bank credit ratings; subsequently, based on this evidence,we need to further investigate using the extended model of equations (1) and (3).

But before proceeding further, we shall infer the economic significance of the above results as explained in the beginning of this subsection. Columns (3) and (4) in Table 4.5 help us assess the magnitude that the coefficient values affect bank ratings, thus also inferring the magnitude of the stickiness effect in the preliminary results. Column (3) presents the average notch effect for all the non-dummy variables, i.e. all financial explanatory variables and the Country Rating, and Column (4) presents the notch effect for the dummy variables or the stickiness effect for each CRA. A bank's country rating is by far the most contributing attribute in determining the bank's rating. An increase/decrease of one standard deviation in the country's rating will on average increase/decrease a bank's rating by Fitch by 1.88 notches, by Moody's by 2.41 notches and by S&P by 2.16 notches. In turn, the most contributing financial characteristic in determining bank credit ratings is the Log of Assets for Fitch and Moody's: an increase/decrease of one standard deviation in log of assets coefficient on average increases/decreases a bank's rating by Fitch by 0.78 notches, from Moody's by 0.67 notches, while for

S&P the most contributing financial characteristic is Other operating income/Average Assets: an increase/decrease of one standard deviation in Other operating income/Average Assets coefficient on average decreases/ increases a bank's rating by S&P by 0.57. We observe the rest of the average notch effect of the remaining financial characteristic variables of the three CRAs in Table 4.5. As far as the stickiness effect is concerned, the average notch effect is the greatest for Fitch, and smallest for S&P. So, e.g. for Fitch the average notch effect of rating stickiness is -0.44 notches, meaning that the if in any of the next 4 quarters a bank's credit rating is changed, i.e. upgraded or downgraded, then then this bank's current credit rating will be lower on average by 0.44 notches due to rating stickiness.

4.4.2. Full sample results for Downgrade and Upgrade Stickiness

Subsequently, we proceed with the ordered logit model of equations (1) and (3) to investigate whether stickiness is different in the event of a downgrade or an upgrade decision. Table 4.6 displays the estimation results, again for the full world sample of banks, for each CRA.

Similar to the preliminary results, the coefficients of almost all financial explanatory variables are uniformly statistically significant and have the same expected signs across CRAs. Furthermore, the values of all the explanatory variables' coefficients in Table 4.6 barely differ from the values of the respective coefficients in Table 4.5. For example, Log of Assets and R.O.A.A. are again highly significant across all three CRAs with positive sign as expected. For Fitch, Log of Assets and R.O.A.A. coefficients in Table 4.5 are 1.175 and 0.118, while in Table 4.6 they are 1.164 and 0.128. For Moody's, Log of Assets and R.O.A.A. coefficients in Table 4.5 are 0.863 and 0.210, while in Table 4.6 they are 0.867 and 0.226. And for S&P, Log of Assets and R.O.A.A. coefficients in Table 4.5 are 0.537 and 0.202, while in Table 4.6 they are 0.867 and 0.226. The similarities that we observe for the coefficients of the financial explanatory variables are equivalent for the coefficients of the Country Ratings variables.

However, contrary to the aforementioned similarities, the coefficients of the two Stickiness dummy variables, which are the focus of this study, present a totally different picture that distinguishes not only upgrade and downgrade stickiness, but also the stickiness practice in bank ratings among the three CRAs. Fitch has negative coefficients for both upgrade and downgrade stickiness, while

Table 4.6: Estimation results for the full sample

Estimation results for the ordered logit model of equations (1) and (3) for the full world sample of commercial banks, for each CRA. The dependent variable is equivalently Fitch, Moody's and S&P long-term issuer ratings as defined above , together wih the financial explanatory variables, andthe Stickiness dummmies. Standard errors are calculated using cluster-correlated robust estimate of variance at the bank level, and the asterisks *, **, and *** next to the coefficients values respectively correspond to significance levels 10%, 5% and 1%.

Fitch				
Variable	**Coefficient**	**Z stat**	$\frac{\textbf{Coefficient} \times \textbf{SD}}{\textbf{Rating Notch Length}}$	$\frac{\textbf{Coefficient}}{\textbf{Rating Notch Length}}$
Log of Assets	1.164***	13.25	0.77	
R.O.A.A.	0.128***	3.87	0.25	
Total Assets/Equity	-0.000***	-9.52	-0.02	
Net Loans/Tot. Assets	-0.012***	-3.40	-0.19	
Dep.&Funding/Tot Assets	-0.002***	-3.18	-0.16	
Oth.Op.Income/Avg Assets	-0.045	-1.09	-0.09	
Country Rating	0.482***	19.75	1.87	
Upgrade Stickiness	-0.756***	-2.94		-0.71
Downgrade Stickiness	-0.224***	10.11		-0.21
No. of observations	26,587			
Pseudo R^2	0.184			
Clusters of Banks	777			
Moody's				
Variable	**Coefficient**	**Z stat**	$\frac{\textbf{Coefficient} \times \textbf{SD}}{\textbf{Rating Notch Length}}$	$\frac{\textbf{Coefficient}}{\textbf{Rating Notch Length}}$
Log of Assets	0.867***	8.75	0.67	
R.O.A.A.	0.226***	4.06	0.54	
Total Assets/Equity	-0.001	-0.31	-0.18	
Net Loans/Tot. Assets	0.005	1.18	0.10	
Dep.&Funding/Tot Assets	-0.000*	-1.68	-0.04	
Oth.Op.Income/Avg Assets	-0.135***	-3.51	-0.39	
Country Rating	0.513***	20.89	2.41	
Upgrade Stickiness	-0.833***	0.10		-0.98
Downgrade Stickiness	0.007	10.04		0.01
No. of observations	22,298			
Pseudo R^2	0.165			
Clusters of Banks	746			
Standard and Poor's				
Variable	**Coefficient**	**Z stat**	$\frac{\textbf{Coefficient} \times \textbf{SD}}{\textbf{Rating Notch Length}}$	$\frac{\textbf{Coefficient}}{\textbf{Rating Notch Length}}$
Log of Assets	0.521***	5.14	0.39	
R.O.A.A.	0.226***	3.85	0.50	
Total Assets/Equity	-0.000***	-8.35	-0.02	
Net Loans/Tot. Assets	-0.006	-1.59	-0.13	
Dep.&Funding/Tot Assets	-0.000	-0.44	-0.10	
Oth.Op.Income/Avg Assets	-0.128***	-3.36	-0.58	
Country Rating	0.521***	20.09	2.15	
Upgrade Stickiness	-0.837***	2.02		-0.91
Downgrade Stickiness	0.161**	11.25		0.17
No. of observations	26,086			
Pseudo R^2	0.1573			
Clusters of Banks	669			

Moody's and S&P have negative coefficients for upgrade stickiness but positive coefficients. The expected sign

for upgrade stickiness is negative, as if in any of the next 4 quarters, i.e. at t+1, t+2, t+3 and t+4, a bank's credit rating is upgraded, then in the presence of upgrade stickiness the bank's credit rating remain at a lower notch until the time the rating upgrade is announced. In other words, in the presence of upgrade stickiness, we would expect a negative factor contributing to the existing rating quality before the rating upgrade takes place (i.e. at t-4, t-3, t-2 and t-1), so that the rating process result in a sticky or unchanged or lower credit rating. In the same fashion, the expected sign for downgrade is positive, as if in any of the next 4 quarters, i.e. at t+1, t+2, t+3 and t+4, a bank's credit rating is downgraded, then in the presence of downgrade stickiness the bank's credit rating remain at a higher notch until the time the rating downgrade is announced.

So, the negative coefficient for downgrade stickiness by Fitch is an unexpected finding that has a different economic interpretation: if in any of the next 4 quarters, i.e. at t+1, t+2, t+3 and t+4, a bank's credit rating is downgraded, the bank's credit rating remains at a lower notch until the time the rating downgrade is announced. Or, in other words, before a downgrade takes place, we would expect a negative factor contributing to the existing rating quality (i.e. at t-4, t-3, t-2 and t-1). We name this case of negative coefficient for downgrade stickiness as pre-downgrade conservatism, since Fitch before the event of a downgrade exerts conservatism on the bank's current ratings. The reason behind this may be that when Fitch observes signs of future deterioration at a bank's credit rating quality (that may eventually lead to a downgrade), it becomes conservative for the current credit ratings (at t-4, t-3, t-2 and t-1 before the downgrade).

Besides the above, it should be emphasized all three CRAs have coefficients for upgrade stickiness that are statistically significant at the 1% level and values close to one. Moreover, while Fitch exerts this negative downgrade stickiness or downgrade conservatism, the other two CRAs have both small coefficients for downgrade stickiness, out of which Moody's downgrade stickiness coefficient is not statistically significant.

But more interesting is the economic significance of the above results as inferred from Columns (3) and (4) in Table 4.6. The observed values of the average notch effect for all the non-dummy variables, i.e. all financial explanatory variables and the Country Rating variables, in column (3) again barely differ from the respective values in Table 4.5 for all three CRAs. So, we focus on the average notch effect for upgrade and downgrade stickiness for each CRA in Column (4).

Our above findings regarding the economic interpretation of the signs of the stickiness dummies are now completed since we also assess the average notch effect of stickiness. Moody's has the largest negative notch effect of upgrade stickiness compared to the other two CRAs that is 0.98 notches, S&P follows with 0.91 notches and Fitch with 0.71. The full economic interpretation is that a bank having all characteristics constant between t and any of the next 4 quarters, i.e. at t+1, t+2, t+3 and t+4, during which a rating upgrade, e.g. by Moody's takes place, its Moody's rating will be lower by 0.98 notches at t, therefore exhibiting rating stickiness. The existence of upgrade stickiness implies that a CRA's bank ratings exhibit more stability vs accuracy at a one-year horizon. So, an alternative interpretation to Moody's having higher upgrade stickiness compared to that of S&P and Fitch is that Moody's bank ratings exert higher stability versus accuracy compared to bank ratings by Fitch and S&P.

With respect to downgrade stickiness, S&P has the largest positive notch effect of downgrade stickiness compared to the other two CRAs that is 0.17 notches, Moody's with 0.01 notches, and Fitch with the negative downgrade stickiness of 0.21 notches. So, besides the unexpected negative downgrade stickiness of Fitch, that we already named downgrade conservatism, we observe that the other two CRAs exhibit downgrade stickiness of an absolute notch effect significantly lower than that of upgrade stickiness. In fact, for Moody's downgrade stickiness is essentially non-existent versus an upgrade stickiness of almost one, and for S&P downgrade stickiness is more than 5 times greater than downgrade stickiness. Therefore, we conclude that for all CRAs upgrade stickiness is close to one notch, while downgrade stickiness is significantly lower.

Lastly, in Table 4.7 we test whether the upgrade and downgrade coefficients in all three samples are statistically different.

Table 4.7: Testing for the equality of Stickiness coefficients across CRAs

Stickiness coefficients and their rating notch length are from Table 4.6 for each CRA. In the last column we observe the *p*-value for the Wald χ^2 test for the hypothesis that all upgrade stickiness or downgrade stickiness coefficients are equal. The asterisks * next to the p-values correspond to significance levels 5% and denote that we are able to reject the null hypothesis

	Fitch		**Moody's**		**S&P**		**Wald test**
	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	*p-value*
Upgrade Stickiness	-0.756	-0.71	-0.833	-0.98	-0.837	-0.91	0.6355
Downgrade Stickiness	-0.224	-0.21	0.007	0.01	0.161	0.17	0.0002*

The null hypothesis that upgrade stickiness coefficients by Fitch, Moody's and S&P are equal is not rejected, while for downgrade coefficients the null hypothesis is rejected indicating that the three downgrade coefficients are not simultaneously equal. Thus, for the full samples we conclude that all three CRAs are aligned in upgrade stickiness, while the opposite holds for downgrade stickiness. This general conclusion may have a different interpretation: all three CRAs are aligned to the degree of conservatism up to 4 quarters before a rating upgrade takes place, while the opposite holds in the event of a downgrade.

One last but very interesting finding when observing Tables 4.6 and 4.7 is the magnitude of the asymmetry observed between upgrade and downgrade stickiness for each CRA when comparing the notch effects. This is evident for all CRAs with S&P having the most asymmetrical stickiness effects.

4.4.3. Results for Investment and Speculative Grade Subsamples

Next, we proceed again with the ordered logit model of equations (1) and (3) but splitting our sample into investment-grade and speculative-grade subsamples as in Blume, Lim, and Mackinlay (1998), Cheng and Neamtiu (2009) and Alp (2013). The purpose of splitting our sample as in most of the related literature is to examine whether there exists a distinct practice for bank rating stickiness in higher versus lower credit quality bank ratings. Investment-grade ratings are ratings of "BBB-"/"Baa3" or better, which translates to a rating scale number of 8 or higher. Speculative-grade ratings are ratings of "BB+"/"Ba1" or better, which translates to a rating scale number of 7 or lower. Table 4.8 displays the estimation results, again for the full world sample of banks, for each CRA, separately for the investment-grade and speculative-grade subsamples.

The two subsamples give differentiated results with respect to both the explanatory variables and the stickiness variables. Key explanatory variables such as Log of Assets, R.O.A.A. and the Country Rating follow a pattern of higher values of coefficients for one subsample and lower values of coefficients for the other subsample. Log of Assets have statistically significant coefficients with the expected positive signs, but higher coefficient values for the speculative-grade subsamples of all three CRAs compared to the values of the respective coefficients of the investment-grade. The same is true for R.O.A.A. coefficients, except for Moody's even though the notch effect that we observe below gives the

same result (i.e. greater notch effect for speculative-grade subsample). Country Rating follows the opposite pattern with higher coefficient values for the investment-grade subsamples of all three CRAs compared to

Table 4.8 Estimation results for Investment- and Speculative-Grade Subsamples

Estimation results for the ordered logit model of equations (1) and (3) for the full world sample of commercial banks, for each CRA, split into investment-grade and speculative-grade subsamples. The dependent variable is equivalently Fitch, Moody's and S&P long-term issuer ratings, and the financial explanatory variables together with the stickiness dummies are defined above. Standard errors are calculated using cluster-correlated robust estimate of variance at the bank level, and the asterisks *, **, and *** next to the coefficients values respectively correspond to significance levels 10%, 5% and 1%.

Fitch						
	Investment Grade			**Speculative Grade**		
Variable	**Coefficient**	**Z stat**	$\frac{\text{Coefficient} \times \text{SD}}{\text{Rating Notch Length}}$	**Coefficient**	**Z stat**	$\frac{\text{Coefficient} \times \text{SD}}{\text{Rating Notch Length}}$
Log of Assets	0.905***	9.54	0.45	1.248***	6.02	0.99
R.O.A.A.	0.093*	1.88	0.14	0.098***	2.77	0.23
Total Assets/ Equity	-0.0001***	-10.42	-0.01	-0.002	-1.02	-0.48
Net Loans/ Total Assets	-0.015***	-3.73	-0.18	0.013*	1.93	0.24
Dep.&Funding/ Total Assets	-0.001	-1.29	-0.05	-0.001*	-1.87	-0.14
Oth.Op.Income/ Avg Assets	-0.015	-0.31	0.02	-0.040	-1.21	-0.10
Country Rating	0.487***	15.04	1.43	0.226***	6.41	1.05
	Coefficient	**Z stat**	$\frac{\text{Coefficient}}{\text{Rating Notch Length}}$	**Coefficient**	**Z stat**	$\frac{\text{Coefficient}}{\text{Rating Notch Length}}$
Upgrade Stickiness	-0.858***	-8.10	-0.61	-0.412***	-3.36	-0.46
Downgrade Stickiness	-0.222***	-2.43	-0.16	-0.457***	-3.25	-0.52
No. of observations		19,560			7,027	
Pseudo R^2		0.114			0.118	
Clusters of Banks		618			311	
Moody's						
	Investment Grade			**Speculative Grade**		
Variable	**Coefficient**	**Z stat**	$\frac{\text{Coefficient} \times \text{SD}}{\text{Rating Notch Length}}$	**Coefficient**	**Z stat**	$\frac{\text{Coefficient} \times \text{SD}}{\text{Rating Notch Length}}$
Log of Assets	0.772***	6.78	0.47	0.972***	4.57	0.91
R.O.A.A.	0.224***	4.15	0.41	0.161**	1.77	0.46
Total Assets/ Equity	-0.001	-0.32	-0.14	0.005	0,61	1.89
Net Loans/ Total Assets	0.002	0.51	0.04	0.012*	1,75	0.29
Dep.&Funding/ Total Assets	-0.0001***	-2.53	-0.04	-0.001*	-1,88	-0.68
Oth.Op.Income/ Avg Assets	-0.126	-2.49	-0.28	-0.026	-0,83	-0.09
Country Rating	0.446***	14.75	1.64	0.199***	6,22	1.13
	Coefficient	**Z stat**	$\frac{\text{Coefficient}}{\text{Rating Notch Length}}$	**Coefficient**	**Z stat**	$\frac{\text{Coefficient}}{\text{Rating Notch Length}}$
Upgrade Stickiness	-0.774***	-8.11	-0.72	-0.177	-1,19	-0.25
Downgrade Stickiness	0.089	1.07	0.08	-0.011	-0,07	-0.02
No. of observations		16,992			7,027	
Pseudo R^2		0.067			0.118	
Clusters of Banks		583			311	

the values of the respective coefficients of the speculative-grade. The remaining financial explanatory variables coefficients' do not follow similar patterns, and also

we observe that their statistical significance varies from one subsample to the other.

Table 4.8 - *Continued*

Standard and Poor's						
	Investment Grade			**Speculative Grade**		
Variable	**Coefficient**	**Z stat**	$\frac{\text{Coefficient} \times \text{SD}}{\text{Rating Notch Length}}$	**Coefficient**	**Z stat**	$\frac{\text{Coefficient} \times \text{SD}}{\text{Rating Notch Length}}$
Log of Assets	0.279**	2.54	0.18	1.001***	4.40	0.79
R.O.A.A.	0.123**	2.27	0.23	0.205**	2.33	0.48
Total Assets/ Equity	-0.0003	-0.31	-0.08	0.003	0.23	0.98
Net Loans/ Total Assets	-0.008*	-1.83	-0.14	0.012	1.38	0.26
Dep.&Funding/ Total Assets	-0.000	-0.06	0.00	-0.002	-1.19	-0.36
Oth.Op.Income/ Avg Assets	-0.086	-1.43	-0.33	-0.047	-1.24	-0.23
Country Rating	0.455***	12.26	1.60	0.263***	5.42	1.15
	Coefficient	**Z stat**	$\frac{\text{Coefficient}}{\text{Rating Notch Length}}$	**Coefficient**	**Z stat**	$\frac{\text{Coefficient}}{\text{Rating Notch Length}}$
Upgrade Stickiness	-0.744***	-7.95	-0.69	-0.766***	-5.83	-0.89
Downgrade Stickiness	0.232***	2.81	0.22	-0.245	-1.52	-0.28
No. of observations		20,272			5,814	
Pseudo R^2		0.061			0.130	
Clusters of Banks		538			268	

With respect to the stickiness variable, the results become even more interesting. We observe that upgrade stickiness coefficients are more negative in the investment-grade subsamples of all three CRAs compared to the speculative-grade subsamples. This is more evident for Moody's but for S&P the difference is very small. The opposite holds for downgrade stickiness but only for Fitch, i.e. downgrade stickiness coefficients are more negative in the speculative-grade subsamples compared to the investment-grade subsamples. For Moody's downgrade stickiness coefficients are very small and not statistically significant, and for S&P the investment-grade subsample has a statistically significant and positive downgrade stickiness coefficient, but a not statistically significant and negative coefficient for the speculative-grade subsample.

All the above results have very interesting economic interpretation. The aforementioned effect of some of the explanatory variables having higher values of coefficients for one subsample and lower values of coefficients for the other subsample is confirmed observing the average notch effect. All three CRAs have significantly higher average notch effect for Log of Assets in their speculative-grade subsamples. The same is true for R.O.A.A. coefficients average notch effect, with Moody's having the least difference (speculative-grade subsample

average notch effect of R.O.A.A. coefficient is 0.46 versus 0.41 for the investment-grade). This effect is translated that CRAs rate banks so that some of the explanatory variables have a diminishing positive or negative effect in their credit rating. I.e. Log of Assets average notch effect diminishes as a bank's credit rating increases or bank size is less important for bank credit ratings as the size of a bank increases. The opposite is true for Country Rating, i.e. for all three CRAs have significantly higher average notch effect for Country Rating in their investment-grade subsamples. In turn, this is translated that Country Rating average notch effect increases as a bank's credit rating increases or a bank's Country Rating is more important for higher bank credit ratings than for lower bank credit ratings.

With respect to upgrade stickiness, Fitch and Moody's have a higher or more negative upgrade stickiness for their investment-grade subsamples, but S&P has lower or less negative upgrade stickiness for their investment-grade subsample. An alternative interpretation is that Fitch and Moody's exert higher stability versus accuracy for their investment-grade subsamples compared to the speculative-grade subsamples, whereas the opposite is true for S&P. With respect to downgrade stickiness, Moody's and S&P have small, but positive as expected downgrade stickiness for their investment-grade subsamples, versus negative downgrade stickiness for their speculative-grade subsamples. Fitch has negative downgrade stickiness for its investment-grade and speculative-grade subsamples. So, now we can distinguish that the unexpected negative downgrade stickiness or downgrade conservatism is only found in all three CRAs' speculative-grade subsamples, but also in Fitch's investment-grade subsample. As expected, this downgrade conservatism is more strong for Fitch's speculative-grade subsample.

Lastly, in Table 4.9 we test whether the upgrade and downgrade coefficients in the investment and speculative-grade subsamples are statistically different. This time only the null hypothesis that upgrade stickiness coefficients in the investment-grade subsample by Fitch, Moody's and S&P are equal is not rejected, while the null hypothesis is rejected for upgrade stickiness coefficients in the speculative-grade and for downgrade coefficients in both the investment and speculative grade subsamples. Thus, we conclude that all three CRAs are aligned only in upgrade stickiness in the investment-grade subsample, while the opposite holds for upgrade stickiness in the investment-grade subsample and for downgrade stickiness in both the investment and speculative grade

subsamples.With respect to the asymmetry between upgrade and downgrade stickiness for each CRA, when observing Tables 4.8 and 4.9 again it is evident when comparing the notch effects. S&P again is having the most asymmetrical stickiness effects.

Table 4.9 Testing for the equality of Stickiness coefficients across Investment and Speculative-Grade Subsamples

Stickiness coefficients and their rating notch length are from Table 4.9 for each CRA. In the last column we observe the *p*-value for the Wald χ^2 test for the hypothesis that all upgrade stickiness or downgrade stickiness coefficients are equal. The asterisks * next to the p-values correspond to significance levels 5% and denote that we are able to reject the null hypothesis

Investment Grade

	Fitch		**Moody's**		**S&P**		**Wald test**
	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	*p-value*
Upgrade Stickiness	-0.858	-0.61	-0.774	-0.72	-0.744	-0.69	0.6560
Downgrade Stickiness	-0.222	-0.16	0.089	0.08	0.232	0.22	0.0001*

Speculative Grade

	Fitch		**Moody's**		**S&P**		**Wald test**
	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	*p-value*
Upgrade Stickiness	-0.412	-0.46	-0.177	-0.25	-0.766	-0.89	0.0021*
Downgrade Stickiness	-0.457	-0.52	-0.011	-0.02	-0.245	-0.28	0.0296*

4.4.4. Structural Breaks in Stickiness

Besides the differences examined for bank rating stickiness with respect to the level of credit quality in bank ratings, we now proceed to examine whether there exist differences in bank rating stickiness when we split our CRAs' samples chronologically. In this way we may examine whether stickiness in bank ratings changes over time in response to financial historical events or periods combined with pressure and criticism that CRAs received in the past, thus inferring structural breaks in bank rating stickiness.. Cheng and Neamtiu (2009) define two periods, the period before the Sarbanes-Oxley Act (SOX)[24] and the period after SOX to examine whether the increased the regulatory pressure and criticism to CRAs improving their credit analysis. In a similar fashion we define three periods to

[24] The Sarbanes-Oxley Act was passed on July 25, 2002 by both the Senate and the House of Representatives in the US, as a response to the financial turmoil caused by the high profile corporate collapse of Enron and WorldCom, in late 2001 and mid-2002 respectively.

investigate whether each CRA changed the stickiness effect found above, as a

Table 4.10 Estimation results for Structural Breaks in Stickiness at the different time periods

Estimation results for the ordered logit model of equations (1) and (3) for the full world sample of commercial banks, for each CRA, split into three different periods: until 2003, 2004-2010, and 2011-2015. In each row the coefficient and rating notch length for each CRA and time period is displayed and in the last column the *p*-values for the Wald χ^2 test for the hypotheses that all coefficients are equal. The asterisks * next to the p-values correspond to significance levels 5% and denote that we are able to reject the null hypothesis

a. **Upgrade Stickiness** (minus expected)

Period:	**until 2003**		**2004-2010**		**2011-2015**		**Wald test**
	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	*p-value*
Fitch	-1.026	-0.909	-0.855	-0.775	-0.829	-0.943	0.6592
Moody's	-0.830	-1,041	-0.719	-0.772	-1.037	-1.193	0.1152
S&P	-0.926	-0.976	-0.880	-0.914	-1.017	-1.128	0.7187

b. **Downgrade Stickiness** (plus expected)

Period:	**until 2003**		**2004-2010**		**2011-2015**		**Wald test**
	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	*p-value*
Fitch	-0.027	-0,024	-0.361	-0,327	0.003	0.003	0.0367*
Moody's	-0.418	-0,524	-0.099	-0.106	0.362	0.417	0.0058*
S&P	1.800	1.897	0.123	0.128	0.295	0.301	0.0000*

response increased criticism in different instances. The first period is until year 2003, that similarly to Cheng and Neamtiu (2009) we assume that the criticism after the 2001-2 high profile corporate collapses led CRAs to changes in the rating methodologies, including the lack of timeliness, accuracy and volatility. We assume that 2003 was a year of adjustment (Cantor and Mann, 2006), and that the second period starts from 2004 and ends in 2010, that the global financial crisis concluded. The third period starts from 2011, after the global financial crisis assumingly again brought changes in the rating methodologies, and ends in 2015, that our sample is concluded. Results for stickiness coefficients and rating notch effects per CRA and the three time periods defined above are shown in Table 4.10.

Our analysis for structural breaks in Table 4.10 is focused only on the two stickiness variables, so results for the remaining coefficients are disregarded. Interestingly enough, the results in Table 4.10 bear similarity with the results in Table 4.7. In Table 4.7 only the null hypothesis that the three CRAs' downgrade stickiness coefficients are equal is rejected. Equivalently, in Table 4.10 only the null hypotheses that each of the three CRAs' downgrade stickiness coefficients are equal across the three time periods are rejected. So, the results of Table 4.10

indicate that there exist structural breaks in 2004 and 2011 for all CRAs but only for downgrade stickiness. In other words, the three principal CRAs did not had a rather different practice in bank rating stickiness in upgrades, during the periods defined above, but each CRA had a different practice in bank rating stickiness in downgrades during the same periods.

Furthermore, we observe that all three CRAs have their upgrade and downgrade stickiness coefficients reduced in period 2004-2010, except for the downgrade stickiness coefficient by Fitch. This finding is confirmed when observing the rating notch effects of stickiness coefficients of all three CRAs in 2004-2010, and it is an indication that CRAs move to improve their bank rating accuracy and rating timeliness. S&P have the most notable reduction in 2004-2010 for its downgrade stickiness with its rating notch length reduced from 1.897 to 0.123. Our overall finding for the reduction of stickiness in 2004-2010 is in line with Cheng and Neamtiu (2009) which similarly find that all three CRAs improve rating accuracy and reduce rating volatility in the period following the 2001-2 high profile corporate collapses.

In the last period of 2011-2015, the opposite occurs for both upgrade and downgrade stickiness coefficients and their respective rating notch effects of all three CRAs, i.e. all three CRAs' upgrade coefficients' rating notch effect become more negative and downgrade coefficients' rating notch effect become more positive. This is translated that in the post-global financial crisis era, CRAs' bank rating accuracy worsens and rating timeliness decreases. With respect to downgrade stickiness we should note that Fitch and Moody's have their coefficients' rating notch effects' signs change from negative in 2004-2010 to positive in 2011-2015, which is the expected sign for downgrade stickiness. So, the unexpected negative downgrade stickiness, that we named previously pre-downgrade conservatism, ends in 2011-2015 for Fitch and Moody's.

The last finding in Table 4.11 is that the asymmetry between upgrade and downgrade decisions observed in the full sample is persistent for each period, i.e. in all periods -except for the period until 2003 for Standard and Poor's – upgrade stickiness is significantly greater than downgrade stickiness. . S&P again is having the most asymmetrical stickiness effects than the other two CRAs but only in the first two periods, and in 2011-2015 Moody's has the most asymmetrical stickiness effects. On the other hand, Fitch is having the least asymmetrical stickiness effects in all periods.

Table 4.11 Estimation results for Structural Breaks on consequent years

Wald χ^2 tests for Upgrade and Downgrade coefficients from the estimation results for the ordered logit model of equations (1) and (3) for pairs of yearly consequent subsamples. The asterisks (*) next to the p-values correspond to significance levels of 5% and denote that we reject the null hypothesis that coefficients are equal.

	Fitch		**Moody's**		**S&P**	
	Upgrade Stickiness	Downgrade Stickiness	Upgrade Stickiness	Downgrade Stickiness	Upgrade Stickiness	Downgrade Stickiness
	p-value	*p-value*	*p-value*	*p-value*	*p-value*	*p-value*
2001 vs 2002	0.7704	0.9538	0.2233	0.2027	0.0049*	0.8669
2002 vs 2003	0.7725	0.3962	0.2778	0.8705	0.6997	0.0020*
2003 vs 2004	0.2998	0.6091	0.3398	0.1904	0.3559	0.0464*
2004 vs 2005	0.2032	0.0044*	0.3921	0.5602	0.5128	0.9893
2005 vs 2006	0.9662	0.7183	0.1368	0.5391	0.0006*	0.5903
2006 vs 2007	0.2628	0.0006*	0.7577	0.4593	0.0086*	0.8836
2007 vs 2008	0.7172	0.9601	0.4562	0.5520	0.8061	0.1106
2008 vs 2009	0.5367	0.0088*	0.1559	0.0169*	0.9793	0.4971
2009 vs 2010	0.0070*	0.0276*	0.5679	0.0311*	0.3203	0.0000*
2010 vs 2011	0.2228	0.1246	0.1430	0.8567	0.0095*	0.5607
2011 vs 2012	0.9811	0.2436	0.0241*	0.7289	0.0142*	0.0034*
2012 vs 2013	0.9568	0.6622	0.5650	0.0002	0.0480*	0.0455*
2013 vs 2014	0.0003*	0.3906	0.3591	0.3934	0.6014	0.0655
2014 vs 2015	0.0000*	0.5529	0.4648	0.0394*	0.8532	0.5065

Nevertheless, all the above findings are prone to the criticism of a bias in defining the time periods for finding structural breaks in bank rating stickiness. Moreover, it is not necessary that all three CRAs have common structural breaks. So, we proceed to estimate the structural breaks in a more intuitive way. In Table 4.11 we split our full sample into yearly subsamples, and for each pair of consequent subsamples' stickiness coefficients we perform a Wald χ^2 test for the hypothesis that upgrade or downgrade stickiness coefficients or are equal.

The results in Table 4.11 allow us to re-define the periods in Table 4.10 and re-assess the structural breaks. We can now define more than three periods for each CRA and thus examine the presence of more structural breaks, but most important is that now we can define different periods for each CRA. So, the periods are re-defined for each CRA as in Table 4.12, according to the findings in Table 4.11. In cases that we have consecutive yearly breaks as for example in 2010/11, 2011/12 and 2012/13 in upgrade stickiness for S&P, we choose only one of the three so as not to end up with too many structural breaks. Again our analysis for structural breaks in Table 4.12 is focused only on the two stickiness variables, so results for the remaining coefficients are disregarded. The most significant new finding of Table 4.12 is the existence of structural breaks in both upgrade and downgrade stickiness coefficients in the newly defined periods for each CRA. So, we observe that each CRA had a different practice in bank rating

Table 4.12 Estimation results for Structural Breaks in Stickiness Coefficients according to the results of Table 4.11

Estimation results for the ordered logit model of equations (1) and (3) for the full world sample of commercial banks, for each CRA and for periods set according to Table 4.12. In each row the coefficient and rating notch length for each CRA and time period is displayed and in the last column the *p*-values for the Wald χ^2 test for the hypotheses that all coefficients are equal. The asterisks * next to the p-values correspond to significance levels 5% and denote that are able to reject the null hypothesis

Fitch

	until 2004		**2005-2006**		**2007-2009**		**2010-2013**		**2014-2015**		**Wald Test**
	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	*p-value*
Upgrade Stickiness	-0.912	-1.13	-1.021	-0.81	-0.726	-0.64	-1.372	-1.61	-0.468	-0.52	0.0112*
Downgrade Stickiness	-0.041	0.04	-1.858	-1.48	-0.169	-0.15	0.013	0.01	-0.162	-0.18	0.0029*

Moody's

	until 2003		**2004-2008**		**2009-2011**		**2012-2015**		**Wald Test**
	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	*p-value*
Upgrade Stickiness	-0.830	-0.80	-0.797	-0.81	-0.555	-0.62	-1.169	-1.33	0.0460*
Downgrade Stickiness	-0.418	-0.52	-0.420	-0.42	0.265	0.30	0.137	0.16	0.0102*

S&P

	until 2002		**2003-2005**		**2006-2009**		**2010-2011**		**2012-2015**		**Wald Test**
	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	Coeff.	Rating Notch Length	*p-value*
Upgrade Stickiness	-1.151	-1.16	-0.966	-1.03	-0.659	-0.67	-0.520	-0.54	-1.609	-1.62	0.0007*
Downgrade Stickiness	2.397	2.43	0.525	0.56	-0.108	-0.11	0.835	0.86	0.002	0.00	0.0000*

stickiness in both upgrades and downgrades during the redefined periods. So, the breaks that we distinguish are for Fitch in 2005, 2007, 2010 and 2014, for Moody's in 2004, 2009 and 2012 and for S&P in 2003, 2006, 2010 and 2012. For the periods that coincide the criticism period after the 2001-2 high profile corporate collapses we observe for each CRA that similarly as above stickiness is reduced and thus all three CRAs improve rating accuracy and reduce rating volatility. A new finding is that is the periods before the global financial crisis of 2007-8, stickiness is further reduced. This can be translated as a lax of rating standards, since stickiness constitute a part of them. In the periods following the global financial crisis of 2007-8, similarly as above stickiness increases, especially upgrade stickiness. This in turn can be translated as a conservatism in rating

standards. For Fitch, in 2014 we observe reduction in stickiness and thus a reduction of conservatism. Last but not least, asymmetry between upgrade and downgrade decisions is confirmed in all the redefined periods as in all our previous results.

4.5. Conclusion

This essay uses a mechanism to model stickiness in bank credit ratings by the three principal CRAs for a worldwide sample from 1988 to 2015. The novelty of our research is that the mechanism used is simple as it is included in a model of prediction of bank ratings, similar to that found in related literature. We define stickiness as the factor incorporated into published ratings that can be quantified as it affects credit quality. Stickiness indirectly impacts rating accuracy and stability, up to 12 months before a bank's credit rating is changed, i.e. upgraded or downgraded. Our initial finding is that bank credit ratings are sticky, i.e. there exists stickiness in all three CRAs' bank ratings. Fitch bank ratings have the greatest average notch effect of stickiness and S&P bank ratings have the lowest average notch effect of stickiness.

Next, we examine whether stickiness is symmetric or asymmetric for upgrades and downgrades in bank ratings. Our findings are clear that stickiness is asymmetric for upgrades and downgrades. The average notch effect of upgrade stickiness is close to one notch, with Moody's bank ratings having the greatest average notch effect of upgrade stickiness and Fitch bank ratings having the lowest average notch effect of upgrade stickiness. The average notch effect of downgrade stickiness is greatest for S&P bank ratings and almost zero for Moody's bank ratings, while Fitch surprisingly has negative downgrade stickiness, something that we named pre-downgrade conservatism, i.e. when a CRA observes signs of deterioration of a bank's credit rating quality that may eventually lead to a downgrade, it becomes conservative up to 12 months before the downgrade takes place keeps the rating lower. The asymmetry between upgrade and downgrade stickiness reveals the CRAs' overall conservative attitude due to the higher stickiness in upgrades, i.e. CRAs need to be more confident that observed changes in an bank's risk profile are likely to be permanent in the event of an upgrade rather than in the event of a downgrade.

Also, we examine whether the three principal CRAs employ a distinct practice for bank rating stickiness in higher versus lower credit quality bank

ratings. We split each CRA's sample into the investment-grade and the speculative-grade subsamples and find an asymmetry in stickiness practices by all three CRA's in the two subsamples. Our results show that Fitch and Moody's, which have higher upgrade stickiness for their investment-grade subsamples, exert higher stability versus accuracy for their investment-grade subsamples compared to the speculative-grade subsamples, whereas the opposite is true for S&P. Moody's and S&P have small, but positive as expected downgrade stickiness for their investment-grade subsamplesThe unexpected negative downgrade stickiness or downgrade conservatism is only found in all three CRAs' speculative-grade subsamples, and also in Fitch's investment-grade subsample.

Lastly, we examine whether there are differences in bank rating stickiness when we split our CRAs' samples chronologically. In this way we assess the existence of structural breaks in stickiness as we are mainly interested to see the reaction of the three principal CRAs to pressure and criticism due to financial historical events, i.e. the 2001-2 high profile corporate collapses and the 2007-8 global financial crisis. There are evidence of a structural break in 2004 and 2011 for all CRAs, but only for downgrade stickiness, while the asymmetry between upgrade and downgrade decisions observed in the full sample is persistent for each period, except for the period until 2003 for S&P. When we reassess the time periods in a more intuitive way, we find evidence of structural breaks also for downgrade decisions. Reaction of CRAs to pressure and criticism due to financial historical events is similar as our initial results for structural breaks, while asymmetry between upgrade and downgrade decisions is confirmed in the redefined periods for each CRA. In both cases, i.e. either in the initial results for structural breaks or in the redefined periods, the reaction that we observe is a decrease for the effect of stickiness in the periods that follow the 2001-2 high profile corporate collapses and an increase in the effect of stickiness in the periods that follow the 2007-8 global financial crisis.

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General Conclusion

This PhD dissertation aims to fill gaps in the scant literature of bank credit ratings. We draw attention to three aspects of bank credit ratings, namely governance, structural shifts and stickiness in rating standards. All three aspects of credit ratings that we examine in the equivalent essays have drawn the attention of market participants and academics on many occasions in the past. Weak corporate governance has been singled out as the leading cause not only for high-profile cases of corporate fraud, but also failure of risk management in banks. Similarly, rating standards and methodologies have been the epicenter of criticism in the aftermath of financial crises. The main novelty of our research is that none of three aspects of bank credit ratings has been examined in the literature of bank ratings. Moreover, the size and the international character of our dataset of bank ratings, which also covers all three principal CRAs, makes our study one of the most comprehensive analysis of bank credit ratings.

In the first essay for governance, we present evidence that a selection of governance variables explain bank credit ratings for all three principal CRAs, after controlling for bank financial characteristics and sovereign ratings that prior literature has shown to be related to bank credit ratings. The same evidence is presented as a preamble of our work using principal components drawn from PCA analysis. Similar evidence to that for governance variables is presented using a set of country institutional components. Interestingly enough, we find no evidence that the relationship between governance variables and bank credit ratings for any of the three principal CRAs changes in the periods before and after the global financial crisis, i.e. for the periods until 2008 and from 2009. Our analysis can be extended with respect to the PCA analysis to further enhance our evidence. Also, further work on this topic could expand the dataset of governance variables, since our dataset is only limited to variables that cover board structure and processes, including risk management functions. This could also help understand the unexpected negative sign for risk management related governance variables that we found. Other governance variables could include ownership structure of banks, financial transparency, managerial compensation schemes, and stakeholder rights. Moreover, it would be interesting to examine whether the relationship of governance and bank ratings is affected by the level of the ratings, e.g. for investment or speculative-grade. Our results also need to be examined with alternative specifications to enhance their robustness. Alternative specifications

could include further analysis for structural breaks for the period that our dataset covers, since our analysis considers only one break/two periods.

In the second essay for structural shifts in bank ratings, we investigate the time-series variation in bank rating standards for each of the three principal CRAs. We focus on the period 2000-2015 and on three different geographical regions. Evidence suggests that there exist three structural breaks, dividing the time-span of our analysis to the period before and after the 2001-2 high profile corporate collapses when credit rating standards tightened, the period before the global financial crisis started when bank credit rating standards loosened, and the period after the global financial crisis when bank credit rating standards tightened. Moody's and Standard & Poor's were rather more aligned in their structural shifts in bank credit rating standards, and all three principal CRAs were unanimous in the hardening of bank credit rating standards for US and Canadian banks in the post global financial crisis period. Fitch, as the last entrant to the credit rating industry, seems to have followed a more conservative policy before the global financial crisis compared to the other two agencies which dominated the market of credit ratings. Our findings conclude with Fitch improving their bank ratings in the presence of competition. Further research on should include an alternative specification for the estimation of structural breaks as a further robustness check, probably in a more intuitive way. Also, we could examine how bank rating standards have performed for investment or speculative-grade bank ratings, and also if there exists evidence for procyclicality or countercyclicality in bank rating standards.

In the third and last essay for stickiness, we propose a simple but at the same time novel mechanism to quantify the factor that affects rating accuracy and stability for bank ratings. When either credit quality changes but the ratings do not, or credit ratings are characterized by slow respondence, then we consider that ratings are sticky. We find evidence that bank ratings are sticky and that there exists an asymmetry with upgrade stickiness being significantly greater than downgrade stickiness. We also find evidence for different stickiness practices among the three principal CRAs, and a further asymmetry in the investment-grade and the speculative-grade bank ratings by the three principal CRAs. Evidence concludes with findings of chronological structural breaks in stickiness practices by the three principal CRAs. We observe a decrease of stickiness in the periods that follow the 2001-2 high profile corporate collapses and an increase in the effect of stickiness in the periods that follow the 2007-8 global financial crisis. This last

finding could lead us to interpret stickiness in bank ratings as an alternative explanation to that of tightening bank rating standards in Essay 2. So, further research is necessary to distinguish the two effects and find the net effect for each in bank ratings. Also, alternative specifications of the model are necessary for robustness checks and further work could also include the effect of business cycles in stickiness.